AGRICULTURAL ENGINEERING

OCTOBER • 1951

ASAE Winter Meeting · Chicago, Ill., December 17-19

THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

WHEN IT HITS STUMPS OR STONES . . . IT

BREAKS AWAY

NEW CASE TRACTOR-MOUNTED PLOW

It's mighty hard to break or bend a plow with no more than the force of its normal draft plus the effect of its own momentum. It's the momentum of the tractor that damages plows when they run into rocks or roots.

For more than a decade Case Centennial Tractor Plows have been guarded by a spring release hitch that "lets go" from the tractor when the load is too heavy. Now . . . for the first time by a major manufacturer in regular production . . . Case applies the same principle to provide the same protection for a tractor-mounted plow.

As built into the Break-Away Latch-On plow for Case "VA" Series Tractors, the spring release is not part of the hitch, but of the plow itself. When it lets go, part of the plow remains on the Eagle Hitch of the tractor. Backing the tractor recouples it automatically, also eases the share away from the obstruction.

A touch of the hydraulic control lifts the plow clear of the obstacle, ready to resume plowing. Normally there is no need for the operator to leave his seat, no more than a minute's interruption. He can go ahead confidently, free from anxiety and annoyance in stony or stumpy land.

The Break-Away Plow reduces the upkeep cost per acre of work. It also increases the acreage per day and, thereby, the *yield per man.* J. I. Case Co., Racine, Wis.

CASE

AGRICULTURAL ENGINEERING

Established 1920

CONTENTS FOR OCTOBER, 1951

Vol. 32, No. 10

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INDEX TO ADVERTISERS

TO OUR READERS: Advertisers in this issue present their products and services for your scrutiny, with confidence in their engineering merit and capacity to meet the requirements for which intended, and with confidence in your appreciation of these contributions to engineering progress in agriculture. By taking occasion, as opportunity offers, to further identify these advertisers and their products as essential in the agricultural-engineering scheme, you will be serving them, your profession, and agriculture more effectively.

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MANY MANUFACTURERS OF AGRICULTURAL, ROAD-MACHINERY AND INDUSTRIAL EQUIPMENT HAVE PROVED THAT IT'S GOOD BUSINESS TO ***WORK WITH CLARK***

PRODUCTS OF CLARK:
TRANSMISSIONS • AXLES • AXLE HOUSINGS
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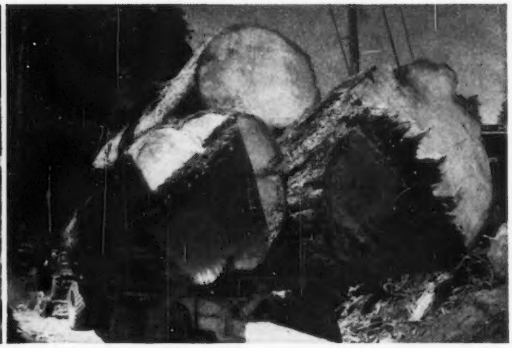
CLARK EQUIPMENT COMPANY
BUCHANAN, MICHIGAN
***Other Plants:* BATTLE CREEK *and* JACKSON, MICHIGAN**

One man hauls two logs easily, with this powerful tractor unit. Mechanized logging not only adds greatly to efficiency, but increases speed and safety in forest operations.



Loads weighing up to 125 tons are carried in one trip on mammoth Weyerhaeuser truck units. Some have two trailers in tandem, making a carrier 100 feet long.

Good Lumber ... *through* Efficiency in Logging

Today, on visiting an efficient logging camp you would clearly see how the operations have been modernized by economical, waste-saving machinery. You would see power driven chain saws helping to harvest the mature trees—powerful "cats" hauling logs to the roads—swift modern cranes loading them—rail cars and great diesel powered truck-trailers delivering them to the mills.

Mechanical progress has made every man-hour vastly more productive in the harvesting of timber. It has opened up new timber resources, by reaching terrain formerly called "impossible" for logging—and thereby saving many mature trees for useful service. Also, mechanized handling reduces log damage and delivers the logs to the mills in condition to produce maximum lumber footage.

Correct logging is but one of the important factors which directly affects the quality and quantity of the lumber yield. The trademark "Weyerhaeuser 4-Square" on lumber also means the coordination of modern timber harvesting, modern reforestation, and modern manufacturing methods. The result is the best in good lumber, which delivers the utmost in sound, economical construction.

One of a series of advertisements defining the important factors contributing to the production of good lumber.

THE LEWISTON, IDAHO MILL

At mills located on the West Coast and Inland Empire, Weyerhaeuser 4-Square Lumber is produced in a range of products from Douglas Fir, Idaho White Pine, Ponderosa Pine, West Coast Hemlock, Western Red Cedar and related species.

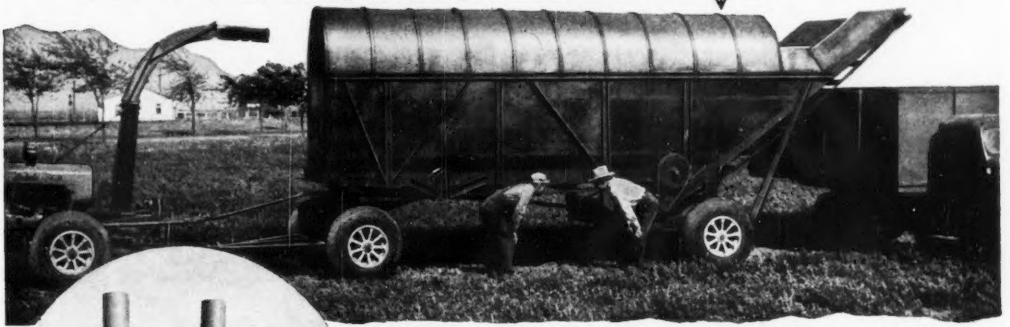
Weyerhaeuser 4-Square Lumber and Services

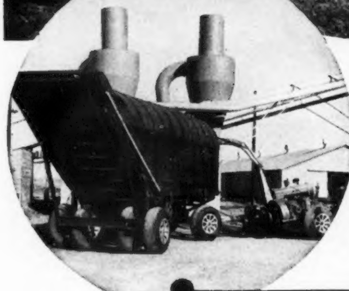
WEYERHAEUSER SALES COMPANY • ST. PAUL 1, MINNESOTA

Self-unloading Alfalfa Trailer saves time, labor and crop

Homemade rig makes it possible to get crop from chopper to drier in 35 minutes, ensuring meal of high carotene content

Mr. Roy W. Mull (left), foreman of the 800-acre E. M. Carter farm near Plainview, Texas, who built the novel trailer, shows Texaco Man C. C. McGlasson that the unloading mechanism is operated by the power take-off from the tractor.





As all farmers know, fast work is necessary to produce green alfalfa meal with a high carotene content. So Mr. Roy W. Mull built the self-unloading trailer pictured above. It holds two truck loads and takes only 25 minutes to fill and 8 minutes to unload. The drier is on the farm, only two minutes' run from the fields. The result is fine green alfalfa meal.

To build the trailer, Mr. Mull used 16-gauge sheet metal, some pieces of 4", 6" and 7" channel iron, an old Plymouth rear end, a second-hand oil field chain and some 2" angle iron for sweeps. Airplane tires were used to keep the vehicle from bogging down in the field. It took Mr. Mull two months, during the winter, to build the trailer which, it is estimated, saves the labor of two men during the five cutting seasons, not to mention the time and crop.

It is significant that men like Mr. Carter and his foreman Mr. Mull, who are constantly seeking more efficient mechanization of agriculture, have found that *it pays to farm with Texaco Products.*

Rear view of tractor-chopper-trailer combination designed and built in the machine shop of the E. M. Carter farm by Foreman Roy Mull. Note drier in background, also owned by Mr. Carter and located on his 800-acre farm. Texaco Products keep all of Mr. Carter's machinery running efficiently.

Mr. G. Alex Bailey (right), of Potosi, Wisconsin, who farms more than 2,500 acres, uses more than 500 pounds of Marfak a year. "Marfak sticks to bearings better, stays on the job longer; there's nothing can beat it," says Mr. Bailey. Lavern Eggers (left) gets ready to lubricate the engine that operates the hay-blower.

"I've found you can't beat Havoline Motor Oil," says Mr. Theodore Nehring (left), big chicken raiser, near Waco, Texas. Havoline now exceeds heavy duty requirements as specified for newest cars, heaviest trucks and tractors. Texaco Man V. L. Gaylor watches Mr. Nehring open a can of engine-saving Havoline.

A brand new motion picture, about a prize dairy cow from Wisconsin, will be shown at Texaco Farm Meetings this fall and winter. See your local Texaco Man for time and place. Bring your family and enjoy yourselves. Free door prizes.

TEXACO

THE TEXAS COMPANY

IT PAYS TO FARM WITH TEXACO PRODUCTS

DIVISION OFFICES: Atlanta 1, Ga.; Boston 17, Mass.; Buffalo 3, N. Y.; Butte, Mont.; Chicago 4, Ill.; Dallas 2, Tex.; Denver 1, Colo.; Houston 1, Tex.; Indianapolis 1, Ind.; Los Angeles 15, Calif.; Minneapolis 2, Minn.; New Orleans 6, La.; New York 17, N. Y.; Norfolk 1, Va.; Seattle 11, Wash.

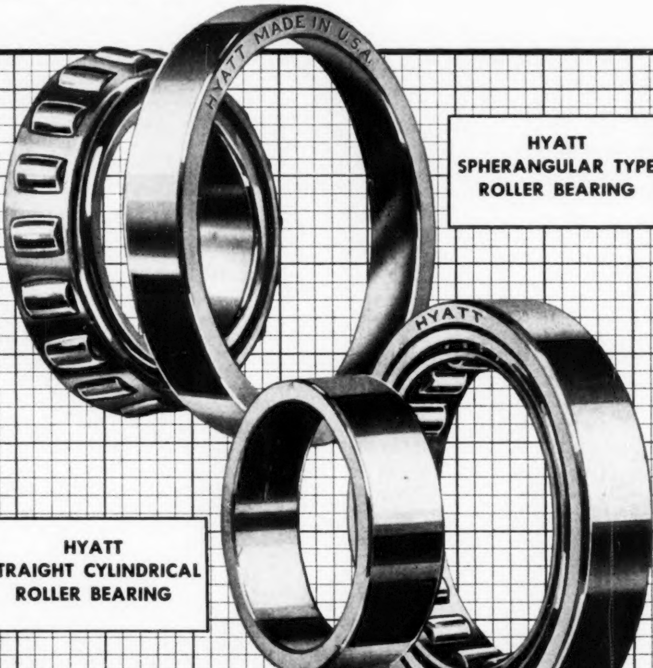
Texaco Petroleum Products are Manufactured and Distributed in Canada by McColl-Frontenac Oil Company Limited.

Preference justified by on-the-job performance

Ever since power-farming equipment was first introduced, Hyatt Roller Bearings have been in there performing satisfactorily.

Starting with the ponderous tractors of years ago, and coming down to the streamlined equipment of today, leading manufacturers, convinced by the outstanding advantages of Hyatts, have built them into tractors, combines, pickers, drills, sprayers, mowers, balers, spreaders, trucks, and other equipment.

And throughout the years, the on-the-job performance of Hyatts has justified the manufacturers in giving preference to Hyatt Roller Bearings on their merit. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.



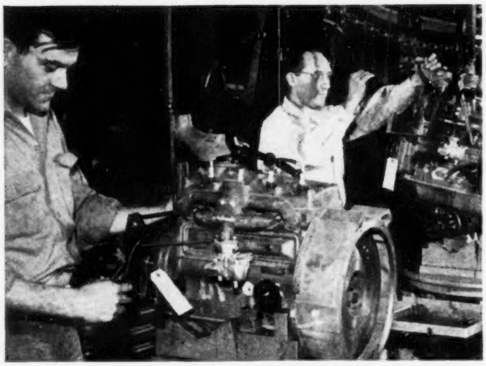
HYATT SPHERANGULAR TYPE ROLLER BEARING

HYATT STRAIGHT CYLINDRICAL ROLLER BEARING

HYATT ROLLER BEARINGS

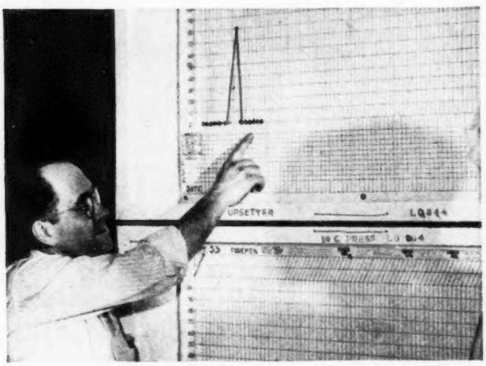
A report to you about men and machines that help maintain International Harvester leadership

International Harvester product quality has 2,774 guardians

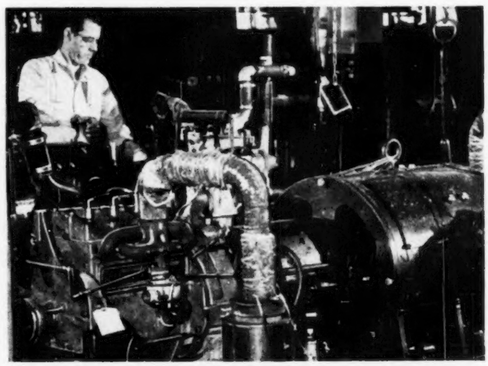


Nearly 3,000 IH inspectors safeguard the quality of IH products. Long experience, averaging 8 to 10 years in most plants, helps them to find tiny imperfections that escape unskilled eyes and ears. These quality guardians check IH products at every stage of manufacture. The McCormick Farmall M tractor, for example, must pass more than 6,000 different inspections during its manufacture to earn the IH trade mark.

They use "black magic" to examine the unseen. A Farmall tractor crankshaft, coated with a fluorescent material, is pictured under the black light detective and magnetic flux reporter of the Magnaflux machine. Here, any tiny imperfections that hide from the naked eye are clearly revealed. Modern equipment like this helps skilled International Harvester inspectors to find and correct production troubles in a hurry.



They mark the route to perfection on statistical quality control charts. The location of each dot represents dimensions of an IH part that is being mass-produced. As long as the dots fall between the narrow quality control limits set by IH engineers, all is well. But if any dots creep above or below the established limits, production is stopped until the trouble is found and remedied.



IH inspectors won't stop checking at the end of factory assembly lines. They give *all* engines dynamometer tests to make sure they deliver rated horsepower. Completed tractors are put through their paces. IH manufacturing inspection engineers, who report on the performance of IH products *after* they leave the factory, also provide a constant check on IH product quality.

INTERNATIONAL HARVESTER

International Harvester products pay for themselves in use—McCormick Farm Equipment and Farmall Tractors . . . Motor Trucks . . . Crawler Tractors and Power Units . . . Refrigerators and Freezers—General Office, Chicago 1, Illinois

EDITORIAL

Editorial Functions

PERIODICALLY some misunderstanding suggests the desirability of reviewing the functions and limitations of this editorial page.

Sometimes our editorials are misinterpreted as official statements by the Society. They are not for several reasons, which we believe may be understandable.

We doubt that it would serve a useful purpose to devote the page to a restatement of platitudes on which our readers would be in general agreement.

We have not yet developed any satisfactory mechanics for obtaining from the membership of the Society, or any representative part of the membership, a monthly consensus of opinion on proposed editorial copy.

There is some foundation for doubt that the Society should go on record on a wide variety of matters beyond the range of the broad general principles and purposes outlined in its constitution and by-laws.

By definition an editorial is a short essay on a timely subject. As such it reflects primarily the viewpoint of the writer.

The one useful purpose which our editorial page can serve, we believe, is in inviting reader consideration of some facts and fancies which come to the editorial writer from various sources, and which seem worthy of further attention. It enables the reader to figuratively sit in the editor's chair for a few minutes and add the editor's viewpoint, for what it may be worth, to the variety of other sources and contacts on which his own information, conclusions, and action are based.

In attempting to serve this purpose we try to avoid being dogmatic. We know engineers too well to try to tell them what to think, believe, or do.

Rarely if ever do we intentionally give our readers the shock treatment of an incredible statement.

When we err in editorial approach, fact, or expression, we are generally called quickly to account by some one or more of our readers, and publish the readers' views for consideration.

With this explanation we hope that our editorial page may be safe for another few months from misinterpretation as either profound dogma or propaganda promulgated by the Society. It is simply intended as a mild stimulant to constructive thought on a variety of subjects, by our readers, whose individual conclusions will be far more important than ours.

Voices from the Past

THE American Society of Agricultural Engineers is now old enough, we believe, to warrant some more or less regular reflection on some of the thoughts of its early leaders.

Recalling some of those early appraisals of our field may bring satisfying recollections to the early leaders who are still with us. They may give new inspiration to some slightly younger members who well remember the personalities involved and some of the early struggle to spread the vision of opportunity for engineering to serve agriculture. To the larger number of still younger engineers they might well prove valuable references on professional perspective.

For example, we quote from remarks by H. W. Riley at the organization meeting of the Society in December, 1907, as published in Vol. 1 of the Transactions:

"Electrical engineering must be taken up by some of us sooner than others, but it certainly is desirable that all our better farmers should know and avail themselves wherever possible of the safety and convenience of electricity for light and power."

In 1907 that may have been a hope, a dream, or sheer clairvoyance as to the direction and extent of rural electric progress to be realized in the next 40 years. What is important is that it was an idea expressed, relayed to others, and kept alive through two decades until rural electrification really caught on and moved ahead on its proven merit.

Early publications of the Society contain numerous expressions of sound concepts worth noting today for more than historical reasons. Opportunity to reprint them will be somewhat limited, but we expect to bring some of them to you in future months in the odds and ends of space ordinarily devoted to miscellaneous filler items.

Scrap Metal

THERE is one apparent weak spot in recurrent programs to salvage scrap metal and make it available for new metal production.

A carload or more of scrap unmoved for weeks or months in an auto graveyard or other dealers' stock pile clearly says to every farmer for 10 or 20 miles around, that he has no public duty to add to that stock pile.

He can afford to speculate as readily as the local dealer, on a price rise on the 100 or 1,000 lb of scrap he may have around. Or as long as other scrap is in sight, he will feel that he can wait to sell his own when it suits his convenience. He has no effective assurance that its early delivery to a dealer will help the defense program, get him a new machine, or pay him as much as it might a year from now.

Scrap metal dealers' stock piles may not actually be excessive. They may be at a practical minimum for efficient handling in the used metal trade. Whether they are or not, we do not profess to know. The appearance and idea that these stocks are excessive and being held for a rise in prices, however, will effectively slow up the collection of scrap from farms and other individually small sources which are important in the aggregate.

Collection of scrap metal from miscellaneous small individual sources will be speeded up considerably, we believe, if incentives and means can be provided to move it more rapidly from local dealers stocks, where it discourages further collection, to mill stock piles where it would facilitate production planning and scheduling.

Technical Aid

WHAT peoples can really be helped by the program of technical aid to the so-called underdeveloped countries?

The question is important to most agricultural engineers as citizens of the country which proposes to be the benefactor.

It will be particularly important to those agricultural engineers considering the personal satisfactions to be earned by participation in the program.

Individual outlook on the possibilities ranges from realization of practical realities and limitations to starry-eyed dreams of conferring upon the whole world the blessings of our particular pattern of civilization.

If the program is to be one of utility rather than futility, it seems apparent that the technical way must be accompanied by the will to live on some higher plane of material well-being than a bare subsistence.

That will to live better must exist or be developed in the mass of population rather than only in its leaders. Without it the result of our "help" will only be a larger mass of subsistence-level problem population awaiting help to become still larger.

Consider Japan, for example. In that comparatively industrialized country the pressure of population on the resources is reported to be greater now than at the time when it pushed the Japanese into a policy of expansion by military aggression. And that pressure of population is still growing under the stimulus of our "help."

If the program is to be humanitarian in fact, it should be humanitarian to future generations. If it is to help people to help themselves it should in many cases deal with some other matters in addition to economic production and life extension.

Relations between quantity and quality of living, present and future living, and the utilization and conservation of resources, involve moral and ethical questions which we have not yet satisfactorily answered for ourselves in our own country.

Our enlightened concept of the *(Continued on page 570)*

AGRICULTURAL ENGINEERING

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The Finger-Wheel Rake

By G. W. Giles and C. A. Routh
MEMBER ASAE

THIS paper reports on research work in developing and testing a side-delivery rake having a new principle of operation.

The basic principle of this machine's operation was first conceived while developing a machine for windrowing sweet potato vines. The vine-row harvester, as this machine was called, consisted of individually floating wheels set in echelon and at an angle to the direction of travel. These wheels were called finger wheels because of the teeth attached to the periphery of the wheel. Pulling a diagonally set wheel results in the fingers producing a drag stroke action which moves the material on the ground in a direction approximately parallel to the axle on which the wheel rotates (Fig. 1). The fingers were curved rearwardly to facilitate the shedding of vines from the wheel without changing the drag-stroke action.

Dynamics of Finger Wheel. So far as is known, the resultant of all forces against a finger wheel of this type due to moving the hay is a horizontal force approximately parallel to the axle of the wheel and slightly above ground level. This is shown by the vector F in Fig. 2. The weight of the wheel is indicated by W. The resultant of these two forces is R. Theoretically, the ideal hitch point for each individual wheel should be slightly below this line when force F is the maximum. This point, indicated at O, will result in the wheel resting as lightly as possible on the ground without it riding over hay. Presumably wear on the teeth and the amount of dirt and dust mixed with the hay should be less. It would also help to eliminate the necessity of counter-balancing the finger wheels such as with a spring S to lower the effective weight of the wheel.

This paper was presented in part at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1950, as a contribution of the Power and Machinery Division. Approved by the Director of the North Carolina Agricultural Experiment Station as Paper No. 394 of the Journal Series.

The authors: G. W. GILES and C. A. ROUTH, respectively, head, department of agricultural engineering and graduate student in agricultural engineering, North Carolina State College, Raleigh.

ACKNOWLEDGMENTS: Credit is due to E. L. Howell and G. B. Blum, Jr., instructors in agricultural engineering, for conducting the efficiency tests. Credit is given to George Wood for his assistance on the development work, and to Ralph Greene, head mechanic, for the construction work.

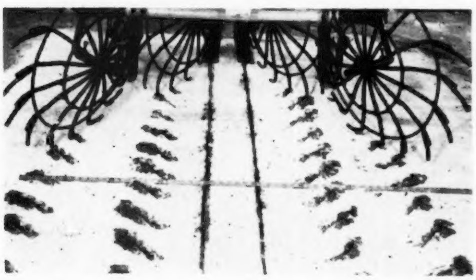

Fig. 1 Rear view of vine-row harvester showing drag strokes caused by the finger wheels

Basic Frames. There are three basic frame arrangements for a rake working on this principle. These are shown in Fig. 3.

The front-mounted, A-type side-delivery is designed to fit a tricycle-type tractor. The first raking finger wheel is set sufficiently far ahead so as to rake the hay from in front of the front tractor wheels. Only the rear right tractor wheel, therefore, will run on the unraked hay. A second half may be added to the right side of the tractor to form an A type. The side force against the front of the tractor is negligible as it will be noticed in Fig. 3 that the center line of resistance passes to the left of the right rear wheel. During the raking operation this line of resistance is shifted to the left depending upon the amount of hay handled and will thus move closer to the center of the rear axle. This frame arrangement has the advantage of giving the operator an excellent view of the operation and providing maneuverability. Also this basic arrangement will permit a long rake with flexibility, this length being essential to low velocity of hay movement as will be explained later. The over-all length of the rake and tractor is 15 ft.

The front-mounted V type or center delivery is the reverse of the A type. The center wheel of the tractor should run in the path of the mower swathboard and each side take a full swath. The frames may be narrowed or widened easily, the amount depending on the width of swath or the size of windrow one desires to make. Each side frame is carried on a wheel and is free to move up or down with the terrain. This movement is in addition to the independent floating feature of each finger wheel. This V frame provides a balanced arrangement and results in a smooth performance. It has, however, the disadvantage of not making a narrow windrow, and of leaving unraked hay under the windrow. Actually two small adjacent windrows having an over-all width of 40 in are formed. This double windrow may be advantageous from the standpoint of rate and uniformity of drying, particularly if a subsequent operation is performed to combine the two. The over-all length of the rake and tractor is 13 ft.

The pull-type side delivery is set off to one side so that the tractor wheels do not run on the unraked hay and so that side forces against the supporting wheels are eliminated. Notice that the line of resistance passes through the tractor hitch

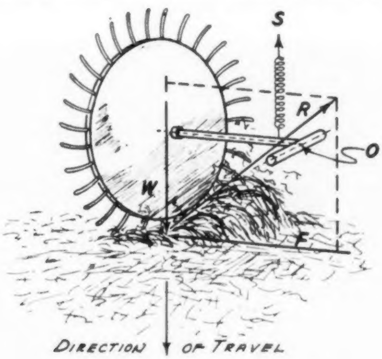

Fig. 2 Vector diagram of forces

point. The side-force component of the pull amounts to approximately 350 lb and is therefore absorbed by the tractor. A lighter rake may be built because no weight is needed to insure the supporting wheels resisting side thrust. This is particularly important when working on the side of a hill. The over-all length of the rake and the tractor is 26 ft.

Basic Wheel Mountings. There are two basic arrangements for mounting finger wheels having the floating feature, namely, the pull type and the push type. The distinguishing difference is in the location of the center of the axle bearing on the tool bar with respect to the center of the wheel bearing. In the first case the axle bearing is ahead of the wheel bearing and thus pulls the wheel. The three rakes shown in Fig. 3 all have pull-type wheels. As previously explained this arrangement is ideal from the standpoint of mechanics.

Fig. 4 shows a push-type wheel mounting. It is obvious that in pushing a finger wheel it is necessary to spring-load or support it in some manner to prevent the teeth from digging into the ground. According to the discussion on "dynamics," this is basically wrong. The rake shown in Fig. 4 has a ground wheel for supporting each finger wheel.

Efficiency Tests. Preliminary efficiency tests were conducted on three types of rakes: (1) front-mounted, A type, side-delivery, finger-wheel rake, (2) conventional type I with reel heads in echelon, and (3) conventional type II with reel heads opposed. The purpose of the tests was twofold: (1) to determine more accurately the value of the finger-wheel rake in order to judge whether more detailed design and development work should be continued and (2) to develop a method and procedure for conducting dependable field-efficiency tests.

Data was taken to compare the three rakes on (1) the amount of dirt, stones, etc., moved into the windrow; (2) maximum distance a stalk of hay was moved (distance of hay line) from its position in the swath to its position in the windrow; (3) the acute angle that the path of this stalk makes with respect to the direction of the forward travel (direction of hay line); (4) average velocity at which the stalk was moved, and (5) leaf loss.

Tests were conducted in six fields as follows: (1) soybeans, 1 ton per acre; (2) lespedeza, 1¼ tons per acre; (3) lespedeza, 1¼ tons per acre; (4) alfalfa, ¾ ton per acre; (5) alfalfa, 1 ton per acre, and (6) lespedeza, 2 tons per acre. A discussion of the results follows.

No statistical analysis was run on the data relating to the amount of dirt, stones, etc., moved into the windrow, as the testing method did not prove satisfactory. Observations and the data collected, however, indicate that there is no difference between the three rakes.

The data taken on distance stalk is moved, angle of movement and average velocity of the stalk is presented in Fig. 9 and Table 1 under the subheading "Analysis of Raking Action" where these data are compared with a theoretical analysis. It will be noted that the distance is less, and the average velocity at which the hay is moved by the finger wheel is less than the two conventional rakes tested. Further conclusions are made under the subheading "Analysis of Raking Action."

The data on leaf loss is considered to be of greater importance. The results are shown in Fig. 6. Leaf loss was determined by taking the weight of leaves from 30 to 50 stalks in a 150-ft swath and the leaves from an identical number of stalks after the windrow is formed. Three or four tests were conducted in each field. A qualitative analysis showed no significant difference among the three rakes. The least significant difference should be 50 per cent on soybeans, 18 per cent on lespedeza, and 20 per cent on alfalfa. The method of sampling was satisfactory for any given field, the 15 per cent coefficient of variation being acceptable. The coefficient of variation, however, between fields was as high as 88 per cent.

If these data are analyzed quantitatively, *there is a difference.* The finger-wheel rake with an over-all average leaf loss of 13.7 per cent will be ranked No. 1; the conventional type I with a 24 per cent loss as No. 2; and the conventional type II with a 27 per cent loss as No. 3. It is impossible, however, to say with certainty how much difference exists between the three rakes.

Other Advantages and Disadvantages. There are a number of advantages and disadvantages to this new type of rake that cannot be brought out in presenting the results of the efficiency tests.

1 The independently floating wheels will automatically fit themselves to uneven terrain such as terraced channels and will thus be more efficient in getting all of the hay. The efficiency tests were conducted on flat, level land where observation indicated there was no difference in the amount of hay left on the ground. Unquestionably, the finger-wheel rake would be superior in this respect if such tests were conducted on uneven land.

2 Some farmers prefer a rake having features for teddering. The merits of such an operation in North Carolina have not been determined. However, anticipating the need, the front-mounted, A-type, side-delivery rake has built into it a feature to permit teddering. The five finger wheels and their axles are removed; the tool bar is detached at the front end and is moved around to a position across the rear of the tractor. The finger wheels are then replaced in the position shown in Fig. 5. The teddering operation leaves five small windrows, the value of which is not known.

3 The windrow formed by the finger-wheel rake is more uniform in size than that formed by the conventional-type rakes.

4 Wind has not interfered with a satisfactory performance of the finger-wheel rake. Also the tool bar in front of the finger wheels has not interfered with windrowing even when operating in heavy hay.

Dead trash left on the ground from previous cuttings will be placed in the windrow by this type of rake.

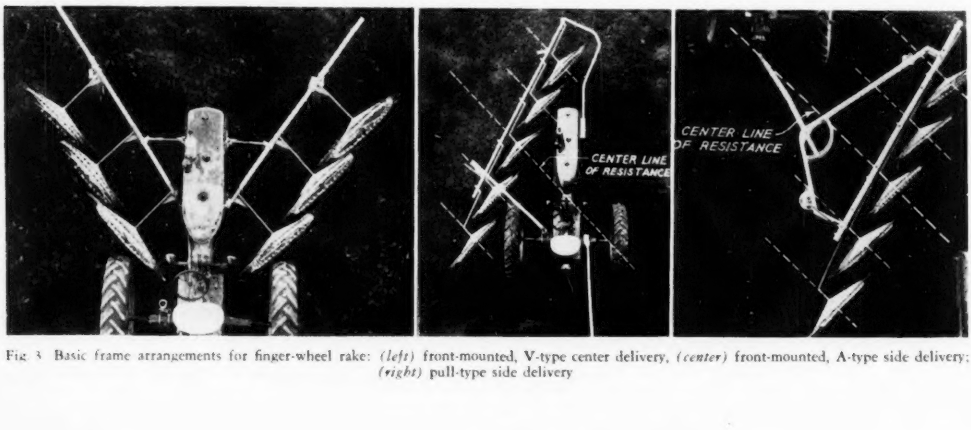

Fig. 3 Basic frame arrangements for finger-wheel rake: *(left)* front-mounted, V-type center delivery, *(center)* front-mounted, A-type side delivery; *(right)* pull-type side delivery

Fig. 4 *(Left)* A push-type basic wheel mounting • Fig. 5 *(Right)* The teddering operation with finger-wheel rake leaves small windrows

Analysis of Raking Action. An analysis of the raking action of the same three rakes used on the efficiency tests was made because of its value for future design work. It is believed that there is a close relation between leaf loss and a number of factors such as distance hay is moved, average hay velocity, and the acceleration and deceleration of the hay. In this analysis, the velocity, direction, and distance of the hay line are determined theoretically and compared with actual measurements. The hay line is defined as the horizontal path of the stalk from its position in the swath to its position in the windrow.

Average Horizontal Tooth-Velocity Component. It will be necessary to first determine the average horizontal tooth-velocity component. Fig. 7 shows example diagrams and calculations for this velocity for two of the three rakes tested, that is, for the finger wheel and conventional type I (calculations for conventional type II would be similar to type I). The conventional type I was pto operated with a gear reduction of 2.1 to reduce the reel speed to 85.2 rpm when operating in third gear with an engine speed of 1500 rpm. This gives a forward speed of 4.71 mph for this rake, a value which was used for both rakes in these example calculations.

Velocity, Direction, and Distance of Hay Line. Knowing the tooth-velocity component and the forward-velocity component, the theoretical resultant tooth velocity, direction of hay line and the distance of the hay line can be calculated. The resultant velocity of the tooth can be computed from the cosine law as follows:

$$V_{RT}2 = V_F2 + V_T2 - V_F V_T \cos C$$

in which

V_{RT} = resultant tooth velocity
V_T = tooth-velocity component
V_F = forward-velocity component
C = angle between tooth component and direction of travel.

The direction of this resultant velocity expressed by its angle Θ to the direction of travel may now be computed by this same law as follows:

$$\cos \Theta = \frac{V_F2 + V_{RT}2 - V_T2}{2\, V_F \times V_{RT}}$$

It can only be assumed in the theoretical calculations that the hay will move along the line of the resultant velocity V_{RT}. This distance can therefore be calculated as follows: Distance $= S_1$ = swath width ÷ sin Θ

It would be in error to assume that the average hay velocity would be equal to the resultant tooth velocity. The average hay velocity should be calculated as shown in Fig. 8 ($V_F/S_F = V_1/S_1$)

Point A on the rake moves to point A_1 while the hay that is picked up at A moves to B_1. Then by the direct ratio in Fig. 8, the average hay velocity is calculated since it takes the same time for A on the rake to move to A_1 and A of the hay to move to B_1.

All of the theoretical values computed for the three rakes and at the forward speed as measured on the efficiency tests are shown under the "theoretical" column in Fig. 9. The measured forward velocity of each rake was used in this instance so that a direct comparison could be made with values secured by actual measurement. The diagrams in Fig. 9 are drawn to scale only for the velocity and angle, these being the more important comparisons. It will be understood that distance of the hay line cannot also be shown to scale.

The values listed in the "measured" column were secured by marking a stalk and measuring its travel distance and its direction with respect to the forward travel. The average hay velocity was calculated as shown in Fig. 8.

TABLE 1. THEORETICAL AND MEASURED VALUES OF AVERAGE HAY

Rake	Hay line angle, deg	Distance, ft	Velocity, mph	Velocity times distance	Difference in hay and resultant tooth velocity, mph
		Theoretical Values			
Finger Wheel	45	9.90	2.39	23.7	1.36
Conventional Type I	58	8.26	4.73	39.1	3.87
Conventional Type II	26	15.95	3.31	52.8	5.48
		Actual Measured Values			Per cent leaf loss
Finger Wheel	42.9	10.7	2.48	26.7	13.7
Conventional Type I	37.0	12.7	4.71	59.8	24
Conventional Type II	21.1	19.9	3.53	70.3	27

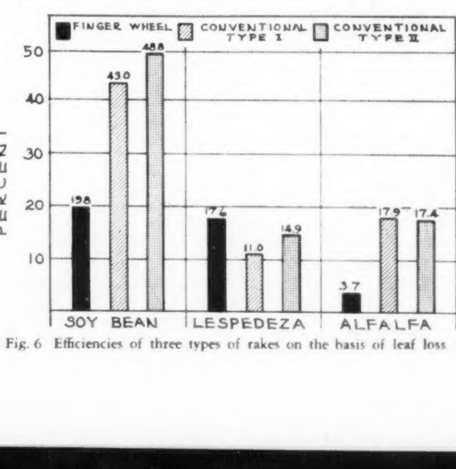

Fig. 6 Efficiencies of three types of rakes on the basis of leaf loss

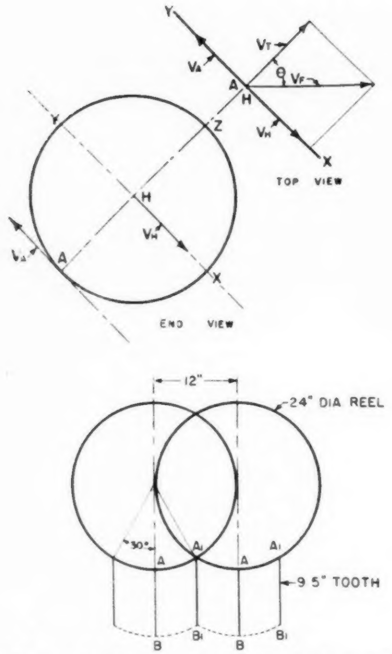

Fig. 7 Diagrams for the average horizontal tooth-velocity component of the finger-wheel and conventional type I rakes. Calculations for this velocity for the two rakes are as follows:

Finger Wheel

V_A = velocity of tooth in plane of wheel with respect to axle
V_H = forward velocity component of axle in plane of wheel
$V_A = V_H$ (these values cancel since in same plane and opposite)
V_F = forward velocity = 4.71 mph
$V_T = V_F \sin\theta = 4.71 \times 0.707 = 3.33$ mph
$\therefore V_T$ = average horizontal tooth-velocity component = 3.33 mph

Conventional Type I

V_F = forward velocity = 4.71 mph
Horizontal tooth contact with hay = 12 in
V_B = horizontal velocity-component of tooth at B
V_A = horizontal velocity of reel at A
$V_B/_A$ = (velocity B respect A) = 0
V_A = radius of reel × rpm × 2π

$$V_B = V\,B/A + > V\,A = 0 + > \frac{1 \times 85.2 \times 2\pi}{88} = 6.07 \text{ mph}$$

Peripheral velocity at B_1 same as $V_B = 6.07$ mph
V_{B1} (horizontal) $= 6.07 \times \cos 30° = 5.24$ mph

$$V_T = \frac{\text{displacement}}{\text{time}} = \frac{2\,r \sin\theta}{T} = \frac{2 \times 1 \times 0.5}{1/(3 \times 85.2 \times 2)} \times 1/88$$

$$T = \text{time} = \frac{\phi}{W} = \frac{60°}{85.2 \times 2\pi} = \frac{1}{3 \times 85.2 \times 2}$$

$\therefore V_T$ = average horizontal tooth-velocity component = 5.80 mph

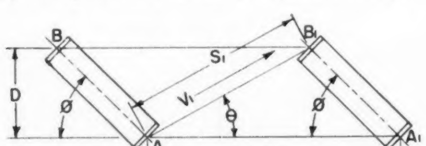

Fig. 8 This illustrates how the average hay velocity should be calculated

DISCUSSION OF RESULTS

All the results both theoretical and measured involving an analysis of hay movement plus leaf loss are shown in Table 1. The measured and theoretical values are nearly the same for the finger-wheel rake while the two conventional rakes show discrepancies. It will be noted that in every case the measured hay-line angle is less than the theoretical and therefore the hay moves a greater distance. It is reasoned that this is due to slippage.

A factor of velocity times distance is added to Table 1 as it will be noted that there is a correlation between this and the velocity-time-distance factor. Under theoretical values in Table 1 a column showing the difference in the hay velocity and the resultant tooth velocity was added. It will be noted that a correlation exists between the measured leaf loss and this difference value. This would be expected since a high resultant tooth velocity would handle the hay more roughly. The ideal rake would make the tooth velocity equal to the hay velocity.

The angle of the reel to the forward travel affects in part the actual velocity of the hay. The less the acute rake angle to the forward travel, the less the velocity of the hay, provided the same forward velocity and raking width are assumed. The angle of the resultant tooth velocity also plays a part in the distance that the hay is moved. The more nearly this angle approaches 90 deg, the less the distance, provided slippage between the tooth and the hay does not occur.

Based upon the above results and statements, it would be concluded that the ideal design would have a 90 deg resultant tooth-velocity direction a resultant tooth velocity equal to or slightly more than the average hay velocity, and a long reel (the longer, the better). From these conclusions, the front-mounted A-type, side-delivery, finger-wheel rake approaches more closely these ideals than the other two rakes studied.

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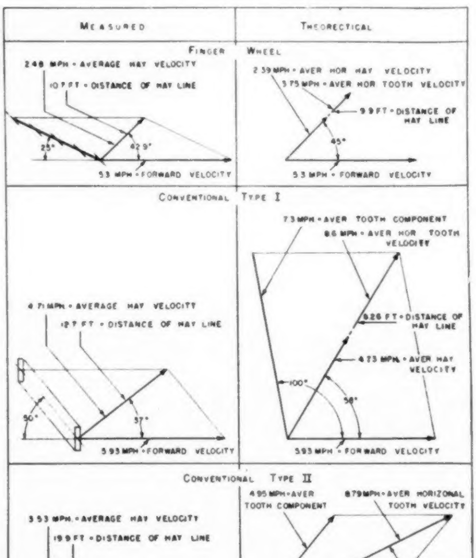

Fig. 9 Comparison of the measured and theoretical values of forward speed for the three types of rakes

The Missouri Farm Water-Management Plan

By Robert P. Beasley
MEMBER ASAE

IN THE states of the Southeast where terracing was first used extensively, fields were small and no large farm machines were used. Each individual field was terraced as a unit discharging the water into the nearest natural depression, fence row or road ditch. This system of terracing proved very satisfactory for that section in the early days when farming operations were on a small scale.

The value of terracing was recognized in other sections of the country and later it was accepted in the Midwest where farming operations were more extensive and larger farm machines were used. The same system of terrace planning which was developed for the share cropper and his horse-drawn equipment was adopted and is still being used in many sections of the country. A discussion relating to this type of terrace planning is given in references (1)* and (2). It is suggested that these articles be reviewed in studying this problem.

Fig. 1 shows the drainage pattern of a 160-acre farm which will be used to discuss the planning of terrace systems.

Fig. 2 shows the farm laid out using the southern method of planning with the terraces discharging into the nearest natural depression.

This plan has some advantages. The terraces are short, there is less variation in terrace spacing, and the grade in crop rows is more uniform than is the case with longer terraces. However, if the areas between the outlets are farmed as individual fields, the shape and size of the fields are limited by the drainage pattern of the land. This variation in field size will make it difficult to plan a modern and effective crop rotation system and the cost of fencing will be excessive. The large number of short rows and small irregular areas will be difficult to farm with modern machinery, will increase the time required to tend the crop, result in many waste areas, and will in general make for inconvenient operation of the farm. This system concentrates the runoff water in the natural depressions causing them to be too soft to cross many times during the season. If they are crossed to obtain greater convenience, there will be the difficulty of miring and breakage of machinery in addition to damaging the outlets.

In the farm as planned, it is difficult to provide convenient access to all fields without crossing terraces, outlets, and other fields. This will not only cause inconvenience in operating the crop and livestock program, but the terraces and outlets will be damaged by crossing and excessive maintenance will be required. If a livestock system of farming is to be followed, it will be difficult and expensive to provide a water supply to the many small fields.

In many areas the broad natural drainageways are the most fertile areas on the farm. The grass outlets placed in these drainageways must be made wide enough to be maintained conveniently, and hence quite a large area of this fertile land will be taken out of cultivation.

Concentration of runoff water in natural drainageways will add to the difficulty of establishing them. With the numerous outlets required there will be more maintenance and a greater problem of controlling overfall erosion.

It was soon recognized that, if terraces were to be most beneficial in Missouri, they would have to be planned so they would not only reduce erosion, but would aid rather than hinder the development of an efficient crop and livestock program. The importance of engineering, soil, crop, livestock, economic, horticulture, home economic, and other specialists working together with the farmer in the development of a plan that will enable him to obtain the best possible living from that farm cannot be overemphasized. In Missouri this over-all planning has been termed "balanced farming."

In working out a balanced-farming plan, the needs of the individual on the farm are given consideration along with the

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*Numbers in parentheses refer to the appended references.

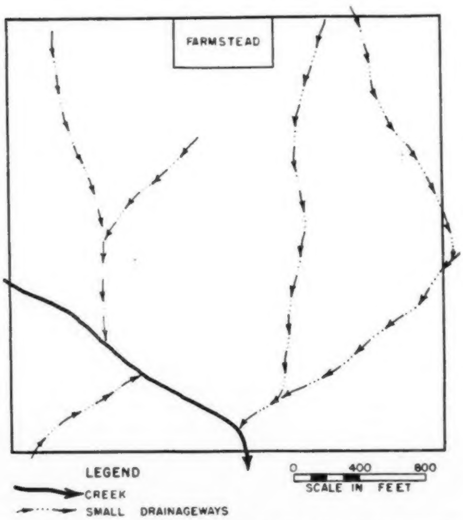

Fig. 1 Drainage pattern of a farm to be used for water-management planning

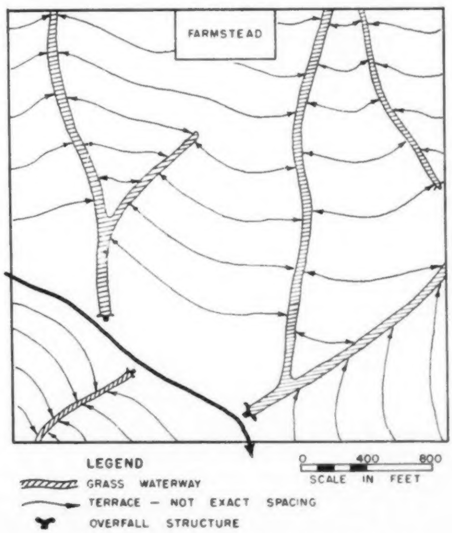

Fig. 2 Farm planned using natural drainageways for outlets

needs of the land. If a man has a 160-acre farm with slopes all greater than 8 per cent the best practice, strictly from a soil conservation standpoint, would be to place the entire farm in grass. This would prevent the farmer from carrying on a balanced-farming program. It would mean reduced income and a low standard of living. To be accepted by farmers, a plan must make it possible for a man to secure a decent standard of living from his farm. The farm must be so planned that he can raise enough crops to meet his livestock needs and still reduce erosion to the point where the productivity of the land can be built up from year to year. This is possible by terracing the land and using well-planned crop rotations and soil-management practices. It does, however, take more planning than if the conservation of the soil were the only consideration.

In determining what practices are necessary on any given farm to maintain or improve its productiveness, a guide is needed which evaluates all the factors involved, so that the need for conservation practices may be based on scientific analysis rather than on opinion. Klemme and Coleman (3) of the soils department of the University of Missouri have given a method of evaluating annual changes in soil productivity for the various crops and methods of utilizing them. The erosion loss resulting from each crop whether farmed with the field boundary, contoured, or terraced is also given.

This method will be used to analyze a part of the farm in Fig. 1 that will be in a three-year rotation of corn, oats plus clover, clover. It is found that the annual change in productivity during the rotation is −1.85 per cent if farmed with field boundaries, −1.08 per cent if contoured, and −0.42 per cent if terraced. If the loss in productivity were to be balanced in each case by additional soil treatments, the annual cost per acre would be $49 if farmed with field boundaries, $29 if contoured, and $11 if terraced. It is evident that, if the farmer wishes to follow this rotation and to maintain the productiveness of his land, it will be an excellent investment for him to have the fields terraced. The terraces will not only reduce the soil loss, but of even greater importance to the farmer, they will enable him to maintain productivity with a minimum expenditure and thus increase his net profit.

CONSIDER WATER-MANAGEMENT STRUCTURES FIRST

If terraces or other water-management structures are needed, they should be considered first in planning because they usually influence the shape and arrangement of fields and the general drainage pattern of the farm. In making the water-management plan, it is necessary that the agricultural engineer and the farmer work together in giving consideration to the operation of the farm.

A complete water-management system should be planned for the entire farm before construction is begun on terraces, terrace outlets, diversion channels, ponds, or any other permanent structure on any part of the farm. A water-management plan may be developed and put into use in a two-year period, or it may extend over a number of years, depending upon the desire of the owner, available labor, financial or managerial limitations. As the plan is developed, each piece of work completed fits into the final plan and returns from it provide increased income which can be used for further development.

In making a water-management plan for a farm, the following principles should be observed:

1 The farm should be planned to meet the need for erosion control on the land. The method previously discussed will serve as a guide to aid in determining the conservation practice needed to effectively reduce erosion under different conditions. If terraces are found necessary, they should be built to such shape that they can be farmed with modern machinery and to such size that their capacity will not be seriously reduced by these farming operations.

Silting basins should be used to intercept water from adjoining land that is not terraced so the silt may be removed before the water enters a terrace outlet. Troublesome hillside gullies should be eliminated by filling in and terracing across. Money, time, and labor that is spent trying to stop hillside gullies, if the water is not removed from them, is usually wasted. Overfall structures should be placed at the ends of grass outlets, where needed, to protect overfalls into main drainageways.

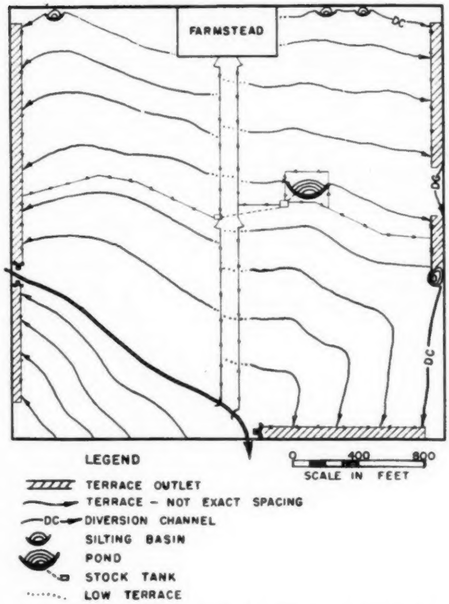

Fig. 3 Farm planned using Missouri water-management system

2 The planned farm must be convenient for the operation of the farm business and so arranged that the water-management structures will not be damaged by the farming operations. In planning a farm, it must be remembered that water-management structures are permanent installations and all farming operations in the future must be carried on with these structures on the land. The most important consideration then in the layout of a water-management plan is to arrange these structures in such a manner that they will offer the least hindrance to the farming operations.

The terrace outlets should be located on field boundaries opposite the point of entrance to the field, whenever possible. Placed in this manner, the outlets will not interfere with farming operations and there will never be occasion to cross them during tillage operations or in going to or from the fields. The outlets will be carrying a relatively large quantity of water and an excellent sod must be maintained to prevent gullying. For this reason the outlets should be fenced so that they can be given the best treatment possible and so they will not be crossed by farm machinery or used as a roadway.

The terraces, if possible, should be near maximum length as this will result in fewer outlets and overfall structures to construct and maintain. The crop rows will be longer and there will be fewer irregular areas to be farmed. As many fields of uniform size as are needed for the crop and livestock program can be secured by fencing between terraces.

The field entrance should be convenient to the center of farming operations and wide lanes should be used to give convenient access to all fields from the farmstead. These lanes should be wide enough to prevent the formation of bare roadways. If made at least 100 ft wide they can also be used as a permanent pasture. The lane should cross the terraces at the extreme upper end and only a very low terrace will be needed to divert the runoff water from the lane. This reduces the necessity of crossing terraces near the lower end where they will be carrying a greater quantity of water.

3 The farm should be planned to make the best possible use of the land. Consideration should be given to the possibility of reducing the need for drainage in low areas by collecting and diverting water from the sloping fields above. Draws or swales should be terraced across to secure drainage and make use of this fertile land.

It is of more importance to the farmer that fields be arranged for efficient operation and for a balance in production of grass, hay and grain crops each year, than that they be divided into many areas based on the present capability of the soil.

4 The plan should provide for a convenient and reliable water supply for stock and household use. Ponds or other sources of supply should be located to provide stock water to all fields used for pasture. A plentiful and reliable supply of pure water should be available for a modern farm home.

5 The farm should be so planned that adjoining property will not be damaged by the conservation practices. In planning water-management systems, problems will be encountered in regard to the legality of intercepting and disposing of the surface water handled by the terraces. In order to avoid any legal difficulties or misunderstanding with the owners of adjoining land the following principles should be followed as closely as possible: The surface water in the terrace system should be carried to the same point to be discharged as the water originally left the farm before the terrace system was established. Water from one watershed should not be diverted to another for disposal from the farm. The flow of surface water from adjoining land should not be obstructed and forced to pond or assume a different course in leaving the land above.

There may be occasions when these principles need not be strictly adhered to if a mutual agreement is reached by the parties involved. This should be a written agreement recorded with the deed to the property so there will be no misunderstanding in case of a change in ownership.

6 The over-all cost of a plan must always be considered and best possible arrangements made to reduce these costs. However, the above factors should not be sacrificed simply to reduce the cost of putting the plan into effect. A poorly planned farm may cost much less than a well-planned farm and may provide the needed protection from erosion, but the added inconvenience of carrying on the farming operations will in a few years far outweigh the smaller initial investment.

Fig. 3 shows farm plan developed with these principles in mind:

1 This plan meets the need for erosion control by terracing the sloping cropland. This was necessary if production was to be maintained most economically. Water from the neighbors' land to the north and east was intercepted by silting basins and carried by diversion channels to the nearest outlet. The natural drains and gullies which had divided the farm into irregular areas can be filled in and terraced across.

2 This plan is convenient for the operation of the farming enterprise and the water-management structures are located so that they will not be damaged by the farming operations. The outlets are along property lines where they will not interfere with farming operations. They can be fenced and properly managed thus reducing maintenance problems. Crop rows are of maximum length making it convenient to farm with modern machinery. Any number of uniform-sized fields desired can be secured by fencing between terraces.

A wide lane is provided giving access to all fields with the shortest travel distance possible. The ease with which livestock and farming equipment can be moved from field to field is readily seen. In transporting crops and equipment from the fields, the terraces need never be crossed except at the extreme upper end where they can be made very low.

3 This plan makes the best possible use of the land. The drainage problem in the low areas along the creek has been eliminated by removing the runoff water from the sloping land above. The natural depressions are drained by terracing across and can now be placed in cultivation.

4 A stock water supply is provided for all the fields, but one, by the pond and two tanks located as shown.

5 The adjoining property is not damaged by this plan. In fact, the removal of the water from the small drain to the east will enable that farmer to eliminate the small waste area between this drain and the property line.

6 All terraces on this plan are near maximum length; consequently a minimum number of outlets and overfall structures are required. This will result in a low initial cost of placing the plan into effect. The structures and outlets are so located that they can be fenced and properly maintained, thus reducing maintenance problems and costs.

A water-management system that is planned according to the above principles enables the farmer to apply modern methods of management to every phase of farming, from rotation of crops and building of the soil to efficient use of machinery and labor, and when integrated with the best soil, crop, and livestock management practices, it will make possible a permanent and potentially increasing business.

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Equipment for Land Leveling

By L. F. Heinl

SMOOTH fields facilitate irrigation drainage and the operation of all field equipment. In many localities leveling operations are limited by the depth of the top soil, but where it is deep enough, a successful leveling job can be performed without leaving it too shallow on the high spots. This paper discussed the equipment available to do this work.

When one is confronted with a job of land leveling, he can select a piece of equipment designed especially for the type of work to be done. If the job involves the moving of large quantities of earth for a considerable distance, the carry-all scraper is best suited. For moving large quantities of earth for a short distance there are several types of equipment available: Drawn scrapers, either roll over or remote cylinder operated, and the integrally mounted rear scraper or the bulldozer. For finish leveling there is the land plane or land shaper and, of course, the wooden float.

The carry-all scraper is a self-loading scraper which, once loaded, carries the load on rubber-tired wheels to the point of discharge. While this type of equipment was designed for large earth-moving jobs, usually encountered in road building, it can be used to advantage in the roughing operation of land leveling. It is available in units small enough for use with a two-plow tractor. The roll-over scraper is the modern tractor-drawn counterpart of the horse-drawn Fresno. It is relatively inexpensive and comes in sizes suited for use with average farm tractors. In a hydraulically controlled land leveler, the depth is controlled by gage wheels or skids, rather than by the altitude of the blade as it is on previously described equipment. This is a very effective tool for rough work and in the hands of an experienced operator will produce a fair finish. Due to the difficulty in accurately gaging a pushed blade, the bulldozer is usually used only for rough work in leveling.

After the major earth-moving work is completed, the field should be finished with one of the various makes of land planes or a wooden float. The wooden float does a fine job of finishing, but is not very efficient. The land plane was developed to produce the smooth finish desired in a more efficient manner. When the leveling blade is properly adjusted, a device of this sort can be drawn across a field and the blade will automatically cut off the high spots and fill the low ones.

It is the responsibility of the agricultural engineer and the implement manufacturers to supply the needed equipment and educate the farmer in its proper use.

Abstract of a paper presented at a meeting of the Pacific Northwest Section of the American Society of Agricultural Engineers at Yakima, Wash., October, 1950.

The author: L. F. HEINL, John Deere Yakima Works, Yakima, Wash.

Physical Dimensions of Rice

By Harold A. Kramer
MEMBER ASAE

PHYSICAL dimensions of rice grains are of vital interest to those engaged in many phases of the rice industry. Manufacturers of rice cleaning and grading equipment are obviously interested. Rice breeders need a guide in their work of developing new varieties of desirable size and shape, as the milling quality and market value of a variety may be influenced by its dimensions. It is believed that the dimensions of a rice grain have an important effect on its drying characteristics. There appears to be very little information in the literature on this subject. This is particularly true of present commercial varieties.

A study of rice seed dimensions was conducted using samples of 35 varieties harvested from the 1949 field plot variety test grown at the Rice Pasture Experiment Station, Beaumont, Tex., and one sample of red rice. The 35 samples from the field plot were grown from pure seed, and it is believed they are truly representative of their respective varieties. The red rice sample was from another source and is not necessarily representative of red rice found in other areas.

The 35 samples were individually harvested and threshed by hand. To avoid possible selection by size, cleaning of the samples was performed by aspiration rather than with a perforated screen. All samples were dried in screen-bottom trays and were stored under equivalent conditions of atmospheric temperature and humidity.

Previous to recording of data, considerable time was spent in the development of a technique of measurement which could be relied upon to produce, with sufficient accuracy, the desired dimensions. A total of seven measurements was made of each rice grain. Two measurements of length were desired for the rough rice seed. The length "over-all" includes the main body of the seed plus the short section of broken stem and the apiculus on the opposite end. The length "seed" includes only the main body of the seed. The width and thickness dimensions are the maximum for their respective sections. After these dimensions were measured, the hull of each seed was removed by hand and the maximum length, width and thickness of the brown rice were determined.

The equipment selected for making the measurements consisted of a ten-power binocular microscope used with a thin steel scale accurately graduated to hundredths of an inch, and a standard micrometer with ratchet attachment. The microscope provided sufficient magnification that, with proper illumination from above and below, length and width dimensions were easily read to the hundredth and interpolated to the thousandth of an inch. Parallax error was negligible. The thickness dimension was determined to the nearest thousandth of an inch with the micrometer.

Of extreme importance was the method of selecting a reasonable number of seeds from the large sample which would be truly representative of the entire population. After repeated experiments a methodical procedure was adopted which would produce substantially the same results when measurements of the same sample were replicated. It was also found that the careful measurement of 20 seeds produced practically the same average dimension as the measurement of 100 seeds from a given sample. All data in Table 1 are from measurements of 20 seeds of each variety.

The average value for each of a variety's dimensions is of interest in comparing general characteristics. The amount by which one variety's dimensions deviate from the average is also of interest as this indicates uniformity within the variety. Statistical methods provide a means for expressing the uniformity of a dimension. The coefficient of variability is commonly used to compare the uniformity of one variety with that of another. Briefly, it is the standard deviation divided by the average, multiplied by 100. This allows a true comparison of uniformity when there are dimensions of different magnitude.

Table 1 contains values found for the average of each dimension and the Coefficient of Variability (C.V.) for each dimension. In each case the average given is the dimension in inches and the smaller the value of the C.V. the more uniform a particular variety is in that dimension. For example, brown rice of the variety Caloro with a C.V. of 3.216 per cent is less uniform in length than brown rice of the variety Calrose with a C.V. of 2.822 per cent. The varieties in Table 1 have been grouped for comparative purposes according to short-grain varieties, medium-grain varieties, long-grain varieties, medium-slender-grain varieties, long-slender-grain varieties, and red rice. Two columns have been added which give ratios of length to thickness and width to thickness for the brown rice of each variety. These ratios may be helpful in classifying varieties. It is also possible that the width-thickness ratio may be an important factor governing the milling quality of a variety.

The author is confident that the data here presented are reliable for the samples used. The reader is cautioned in using these data to remember that they are based on varieties grown during one season at one location. Unfortunately, it is not known what effect differences in fertility, soil type, irrigation, climate, and other factors may have on average dimensions and uniformity of a variety. It is hoped that this work will be repeated using the same varieties grown under other environments.

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

The author: HAROLD A. KRAMER, formerly agricultural engineer, divisions of agricultural engineering, U.S. Department of Agriculture.

The Finger-Wheel Rake

(Continued from page 540)

CONCLUSIONS

The results of the research work accomplished to date indicates that the finger-wheel rake has promise of being a superior rake for the Southeast area of the United States.

There are three major steps remaining: (1) further testing of this and other rakes for more accurate analysis of raking action, resulting windrow, and leaf loss as a basis for improved future design; (2) further development and refinement of the operating principle of certain pertinent parts of this machine, and (3) redesign of the complete machine so that all parts lend themselves to good manufacturing procedures.

Pertaining to the further development of the finger-wheel rake, data on the following are particularly needed:

1 Optimum angle of operation for the finger wheel. Observation and theory indicates that 45 deg would be ideal.

2 The effect of the finger wheels on raking action.

3 The relationship of forward travel and weight of hay being moved to the distance, direction, and velocity of the hay.

4 Peripherial speed of rotation and shape of the wheel on the character of the windrow. Preliminary work indicated that a cone-shaped wheel may have merit.

5 Shape and design of the finger.

6 A wheel foot or otherwise supported to keep the fingers out of the dirt. Preliminary work with a spring foot for supporting the wheel has considerable merit.

7 Dynamics of the wheel.

8 The value of a teddering operation as performed by a machine working on this principle.

TABLE I. AVERAGE DIMENSIONS AND COEFFICIENT OF VARIABILITY FOR RICE VARIETIES

Variety		Rough Rice Length Over-all	Rough Rice Length Seed	Rough Rice Width	Rough Rice Thickness	Brown Rice Length	Brown Rice Width	Brown Rice Thickness	Ratio L/T	Ratio W/T
Short Grain Varieties										
Calrose	Avg. (in.)	0.313	0.267	0.119	0.081	0.226	0.099	0.073	3.096	1.345
"	C.V.(%)	3.696	2.944	3.465	3.338	2.822	4.360	3.337		
Caloro	Avg. (in.)	0.287	0.241	0.135	0.091	0.208	0.115	0.084	2.476	1.373
"	C.V.(%)	2.767	2.734	3.175	2.064	3.216	3.748	2.381		
Medium Grain Varieties										
B4112A5-5-1	Avg. (in.)	0.355	0.295	0.117	0.082	0.265	0.099	0.074	3.581	1.333
"	C.V.(%)	3.132	3.925	4.018	3.613	3.769	4.426	3.547		
C6-I-25-12	Avg. (in.)	0.344	0.284	0.124	0.085	0.260	0.108	0.076	3.421	1.409
"	C.V.(%)	2.609	2.914	3.924	3.260	3.896	4.958	3.347		
Blue Rose	Avg. (in.)	0.345	0.284	0.128	0.085	0.256	0.109	0.077	3.325	1.405
"	C.V.(%)	4.655	3.975	3.930	4.051	4.578	4.729	4.526		
Early Prolific	Avg. (in.)	0.345	0.286	0.123	0.081	0.254	0.105	0.074	3.432	1.419
"	C.V.(%)	4.270	5.087	4.099	2.642	4.996	4.666	2.874		
B4310A-20	Avg. (in.)	0.340	0.279	0.123	0.083	0.250	0.104	0.074	3.378	1.395
"	C.V.(%)	2.397	3.566	4.390	3.662	3.244	4.942	1.018		
Magnolia	Avg. (in.)	0.339	0.281	0.120	0.080	0.249	0.102	0.073	3.411	1.398
"	C.V.(%)	2.820	3.228	3.583	2.875	3.876	4.931	2.288		
B438A1-104-4	Avg. (in.)	0.339	0.282	0.121	0.082	0.249	0.102	0.075	3.320	1.364
"	C.V.(%)	4.572	4.819	4.593	3.128	3.992	5.598	3.480		
Zenith	Avg. (in.)	0.328	0.271	0.119	0.077	0.244	0.099	0.069	3.536	1.433
"	C.V.(%)	3.299	3.387	5.435	4.182	3.873	7.101	3.927		
Lacross 250	Avg. (in.)	0.326	0.270	0.126	0.086	0.237	0.109	0.078	3.038	1.396
"	C.V.(%)	3.528	2.526	4.246	4.000	4.578	5.138	4.449		
Long Grain Varieties										
B47-3743	Avg. (in.)	0.397	0.334	0.094	0.076	0.311	0.081	0.069	4.507	1.172
"	C.V.(%)	4.297	4.320	5.936	2.413	3.952	7.428	2.532		
Bluebonnet	Avg. (In.)	0.396	0.333	0.098	0.076	0.304	0.085	0.069	4.406	1.238
"	C.V.(%)	3.652	3.363	3.874	2.862	4.609	4.941	2.917		
Nira	Avg. (in.)	0.386	0.320	0.102	0.079	0.300	0.088	0.072	4.167	1.231
"	C.V.(%)	4.041	4.628	2.348	2.596	4.657	4.648	2.568		
Bluebonnet 50	Avg. (in.)	0.387	0.323	0.097	0.074	0.298	0.086	0.067	4.448	1.282
"	C.V.(%)	3.349	3.464	2.808	2.439	3.809	3.756	2.821		
Fortuna	Avg. (in.)	0.385	0.325	0.110	0.078	0.293	0.092	0.071	4.127	1.308
"	C.V.(%)	5.013	6.452	3.464	3.857	4.321	4.253	3.859		
B46-4799-1	Avg. (in.)	0.383	0.320	0.103	0.077	0.292	0.088	0.070	4.171	1.245
"	C.V.(%)	5.326	4.225	3.947	2.842	4.750	3.298	3.126		
Improved Bluebonnet	Avg. (in.)	0.373	0.310	0.095	0.074	0.290	0.081	0.067	4.328	1.213
"	C.V.(%)	4.128	4.290	3.811	2.459	3.806	3.129	3.423		
C.I. 8343	Avg. (in.)	0.374	0.306	0.111	0.076	0.281	0.097	0.069	4.072	1.400
"	C.V.(%)	4.171	3.944	3.729	2.394	2.883	4.487	2.464		
Prelude	Avg. (in.)	0.366	0.311	0.118	0.080	0.277	0.099	0.072	3.847	1.369
"	C.V.(%)	5.847	6.531	4.390	4.349	6.379	4.889	4.917		
RN (C.I.8975)	Avg. (in.)	0.354	0.293	0.100	0.075	0.269	0.089	0.069	3.899	1.285
"	C.V.(%)	4.034	4.911	1.051	2.427	3.911	1.585	2.739		
Long Slender Grain Varieties										
Texas Patna 49	Avg. (in.)	0.401	0.332	0.097	0.073	0.307	0.081	0.065	4.723	1.236
"	C.V.(%)	2.825	3.494	4.103	4.096	3.296	5.098	4.477		
B4033B44-11-4	Avg. (in.)	0.387	0.319	0.094	0.074	0.295	0.082	0.068	4.338	1.203
"	C.V.(%)	3.682	3.329	3.989	3.381	3.624	4.140	3.772		
B4031A1-24-1-2	Avg. (in.)	0.381	0.320	0.094	0.073	0.294	0.079	0.066	4.455	1.198
"	C.V.(%)	3.307	2.951	4.521	2.242	3.704	4.367	2.330		
Century 56	Avg. (in.)	0.381	0.324	0.091	0.073	0.292	0.076	0.066	4.424	1.153
"	C.V.(%)	3.955	3.491	4.066	2.041	3.675	5.000	2.712		
Rexark	Avg. (in.)	0.377	0.323	0.095	0.077	0.290	0.080	0.071	4.085	1.140
"	C.V.(%)	4.130	4.901	4.621	3.377	4.576	5.825	4.422		
Century 52	Avg. (in.)	0.374	0.314	0.095	0.072	0.289	0.080	0.065	4.446	1.227
"	C.V.(%)	3.074	3.599	3.779	2.972	3.547	4.175	2.538		
Century 231	Avg. (in.)	0.369	0.310	0.096	0.073	0.285	0.081	0.065	4.385	1.243
"	C.V.(%)	3.130	3.984	3.710	2.997	3.726	3.228	2.800		
Rexoro	Avg. (in.)	0.379	0.316	0.093	0.070	0.285	0.080	0.064	4.453	1.258
"	C.V.(%)	3.435	3.098	3.206	2.789	2.902	3.771	3.339		
Hill Patna	Avg. (in.)	0.378	0.308	0.093	0.072	0.284	0.080	0.066	4.303	1.218
"	C.V.(%)	5.735	4.588	3.151	3.927	4.630	4.025	4.076		
7/8 Rexoro (C3-12)	Avg. (in.)	0.369	0.310	0.094	0.072	0.282	0.082	0.065	4.338	1.250
"	C.V.(%)	3.691	3.565	3.392	2.722	3.387	3.659	2.931		
Texas Patna	Avg. (ins.)	0.367	0.300	0.094	0.070	0.276	0.080	0.063	4.381	1.274
"	C.V.(%)	3.011	3.883	5.729	2.450	4.351	4.145	2.843		
B43-280-1-4	Avg. (ins.)	0.362	0.296	0.094	0.071	0.275	0.080	0.064	4.297	1.254
"	C.V.(%)	5.124	6.037	3.434	3.808	5.400	2.735	4.023		
Medium Slender Grain Varieties										
B4031A1-1-13-1-12	Avg. (in.)	0.329	0.270	0.098	0.072	0.251	0.084	0.065	3.862	1.278
"	C.V.(%)	3.897	3.885	4.240	3.342	3.759	4.846	2.665		
B44-2647-3-1	Avg. (in.)	0.314	0.257	0.111	0.077	0.230	0.093	0.070	3.286	1.327
"	C.V.(%)	4.012	3.946	3.351	2.164	3.769	4.043	5.057		
Red Rice Variety										
Red Rice	Avg. (in.)	0.342	0.264	0.115	0.074	0.232	0.097	0.066	3.515	1.473
"	C.V.(%)	6.477	5.879	3.562	4.205	5.069	4.437	4.327		

Automatic Shutoff Device for Ground-Grain Conveyor

By C. K. Otis, A. E. Domning and S. J. Otis
MEMBER ASAE MEMBER ASAE

FEED-PROCESSING and handling equipment used in a experimental dairy barn at the University of Minnesota is described in a paper by W. F. Millier (see opposite page). One step in this process involves transporting ground feed from the storage bin in the feed-processing building to a feed hopper located in the milking room. For this purpose a 4-in screw conveyor is used.

To eliminate the possibility of spilling feed due to overfilling and to avoid requiring the operator to stand by while the hopper is being filled, it was considered desirable to incorporate a device that would automatically shut off the conveyor (Fig. 1). This would enable the operator to go about his work of getting ready for milking while the bin was being filled with ground grain. Once the conveyor was turned on, it would need no further attention by the operator.

The automatic shutoff device employed consists of three parts: (1) a gap in the steel conveyor trough lining to permit the grain to flow out of the trough before reaching the end of the conveyor, (2) a divided duct carrying grain to the feed hopper in the milking room, and (3) the shutoff switch. The principle of operation is as follows: The operator starts the conveyor motor by pressing the start push button (See wiring diagram, Fig. 2). The screw conveyor then discharges the ground grain into side A of the divided duct (Fig. 3). The grain slides down the duct into the feed hopper in the milking room. When the ground grain builds up and blocks the opening of the duct into the feed hopper, the duct fills up until the ground grain completely fills side A. The grain then spills over into side B and falls on the aluminum paddle of the automatic shutoff switch. This causes the spring support to bend down and operate the switch that breaks the circuit to the motor controller and stops the motor. As the ground grain is used from the hopper, both sides of the duct clear, the paddle resumes its normal position and the automatic shutoff switch again closes so that the motor can be started again by the manual start button. The manual stop button can be used at any time to stop the conveyor if desired.

In referring to the wiring diagram (Fig. 2), it can be seen that the shutoff switch is in series with the manual stop button so that either switch can shut off the motor. Once the

(Continued on page 549)

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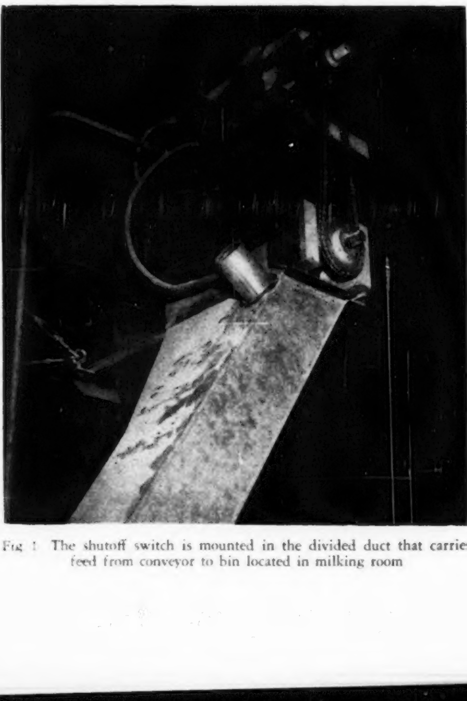

Fig. 1 The shutoff switch is mounted in the divided duct that carries feed from conveyor to bin located in milking room

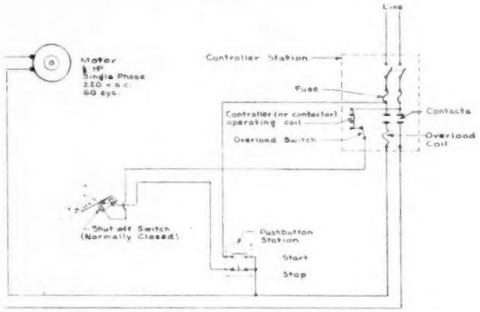

Fig. 2 Wiring diagram for conveyor motor and controls

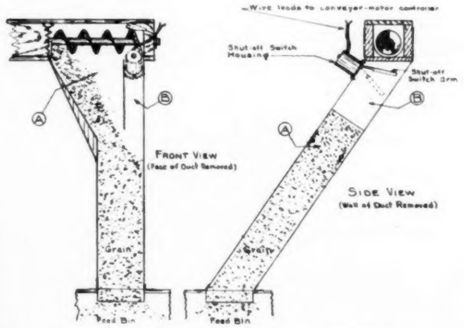

Fig. 3 The automatic shutoff device consists of three parts: (1) gap in bottom of conveyor trough, (2) a divided duct, and (3) the shutoff switch

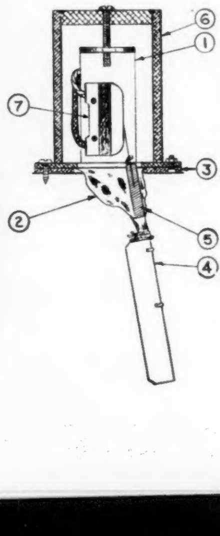

Fig. 4 Cross section of shutoff switch showing (1) frame, (2) dust seal, (3) base plate, (4) switch actuating paddle, (5) flexible paddle arm, (6) switch housing, and (7) switch

Batch Weighing and Processing of the Dairy Ration

By William F. Millier
MEMBER ASAE

PREPARATION of livestock rations from homegrown grains on the farm has resulted in the development of labor-saving equipment for farm feed processing. Some of this equipment is being investigated at the University of Minnesota's Rosemount Experiment Station.

As is the case with similar problems on the farm, setting up labor-saving equipment for weighing and processing the feed at the Rosemount Station involved working with buildings already in existence and incorporating grinding and mixing equipment that had previously been purchased.

The feed-storage building, originally used for feed storage at another location, is an old building that was moved to its present site adjacent to the milking room of the experimental loose-housing dairy barn as shown in Fig. 1. The bottoms of the overhead bins are level and have two discharge openings to facilitate emptying. They are filled through roof hatches by means of a portable elevator.

The problem was to use these overhead bins for storage of whole grain (oats, corn and barley) to provide space along one side of the ground floor for a tractor and/or truck, to provide storage space on the ground floor for sacked oil meal, salt and other supplemental ingredients of the ration, to provide for grinding, mixing and some storage of the ground feed, and to transport the finished product to the milking room for feeding. A further requirement was to keep the space above the milking stalls as free as possible of supporting columns so that various types and arrangements of milking rooms could be constructed and studied.

A solution that appeared to fit fairly well with the limiting conditions is the subject of this paper and is the scheme that is shown diagrammatically in Fig. 1.

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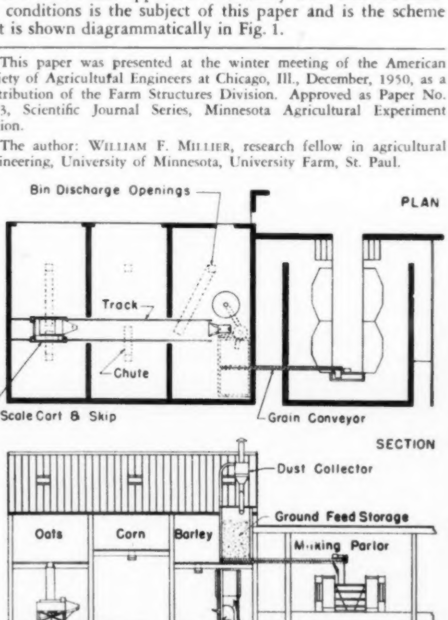


Fig. 1 Layout of buildings and equipment showing the scheme of operation for feed handling at the Rosemont dairy farm

The whole grains flow by gravity from the bins on the second floor to a large box called a grain skip. The grain skip rests on a four-beam concrete aggregate weighing scale. The scale is carried on a steel cart that can be moved along a steel track on the floor below the storage bins. Each of the grains used in the feed ration is weighed in the grain skip.

After the oats, corn, and barley have been weighed, the cart, scale, and skip are moved to the hammer mill. Here the grain skip is raised to charge the hammer mill. A blower attached to the mill moves the grain up to the dust collector from which it is directed into the feed mixer. The bran, soybean oil meal and other ingredients are added to complete the ration during the mixing. The ration flows by gravity to the hammer-mill blower and again through the dust collector to a large hopper-bottom storage bin on the second floor. The ration is carried from the storage bin to the milking room by a screw conveyor.

The operation of the system is carried out in the following manner: Fig. 2 shows the grain skip in position under the oat bin. The hinged chute is lowered by rope and pulleys to discharge the oats into the skip. The flow of grain is controlled by a gate in the bottom opening of the overhead storage bin. This gate is operated through cables by a lever attached to the wall. The operator watches an over-under indicator on the top of the scale and closes the flow gate when the hand indicates zero. The chute is raised to the ceiling and the skip is moved under the next bin.

This process is repeated under each of the whole-grain storage bins and the cart, scale, and skip are then pushed up to the hammer mill. The front of the skip engages a fulcrum bar supported by two channels. A bar to which the hoisting cables are attached is slid into notches at the bottom of the back end of the skip. A two-drum hoist at the top of the channels raises the back of the skip to discharge the grain in the hammer mill.

With the grain skip in the raised position as shown in Fig. 3, all the grain will flow by gravity into the hammer mill. Since the hoist is a worm-and-gear type, no brake is necessary to keep the skip in the raised position.

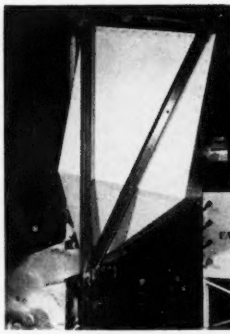
The flow of grain from the skip to the mill is controlled by an adjustable flow gate on the front of the skip shown in Fig. 4. The lever operating the flow gate may be locked in any position to obtain a uniform rate of feed equal to the capacity of the hammer mill.

Fig. 2 Loading the grain skip. Note wall lever for controlling flow of grain, rope for raising and lowering chute, and sliding cover on top of skip

The dust collector is located inside the feed-processing building. The chain-operated gate below the dust collector directs the feed by gravity either to the mixer or the hopper-bottom storage bin.

A 4-in screw conveyor carries the ground feed from the bottom of the hopper storage bin into the milking room. The conveyor is in a wood trough with a round steel bottom. It is powered with a ½-hp gearhead motor.

This conveyor drops the feed into a small storage bin in the milking room. It is a hopper bin with an opening in the bottom from which the feed is taken during feeding. When this small bin becomes empty, the milker starts the conveyor motor by pushing a switch at the side of the hopper. When hopper is filled the conveyor motor is automatically shut off.



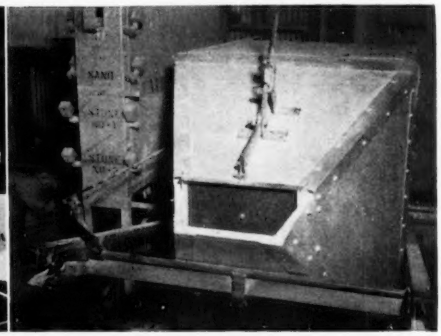


Fig. 3 *(Left)* Skip in raised position at hammer-mill flow is controlled by gate shown in Fig. 4. Feed mixer and mixer unloading chute can be seen at left • Fig. 4 *(Right)* Front end of grain skip showing coupling that engages fulcrum-bar safety latches that can be released from rear of skip, lever-operated flow gate to control flow of grain to grinder, and scale levers for weighing grains in sequence

Some of the details of construction used in carrying out the scheme described above are as follows:

Grain Skip. The grain skip, which has a capacity of 800 lb of the grains used in the ration, is constructed of ¾-in plywood bound at the joints with 18-gage galvanized sheet metal (Fig. 4). The front of the skip is tapered and closed on all sides to form the pouring spout. The opening at the front of the skip is equipped with an adjustable-flow gate that may be locked in any position. The top of the skip is partially covered with a sliding door to permit easy loading and to prevent the grain from spilling when the skip is raised. The skip is slung between two 3-in steel channels, the front ends of which are notched to slide over a fulcrum bar in front of the hammer mill. Spring-loaded safety latches are provided to prevent the skip from being knocked off the fulcrum when it is raised.

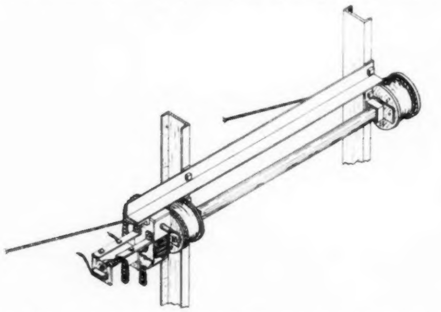


Fig. 5 This special two-drum worm-and-gear hoist raises the grain skip as shown in Fig. 3

The back ends of the skip channels are also notched to receive the 1-in diameter steel bar, to the ends of which are attached the two ¼-in steel hoisting cables. The cable bar is held in the notches by spring-loaded latches.

Scale Cart. The grain skip rides on a scale which is mounted on a four-wheeled cart. The flanged wheels roll on rails made from steel bars 1½ x ¾ in. This track is level and the loaded skip is easily rolled by hand. A foot-operated brake that keeps the scale cart positioned at the hammer mill for receiving the grain skip after grinding can also be seen.

The Scale. The scale used is a four-beam Fairbanks-Morse aggregate-weighing scale. The top beam is the tare beam. The second, third, and fourth beams are preset for the weight of each of the three grains used in the ration. The beams are engaged by moving the weighted levers at the end of the scale cabinet individually and successively until the skip is loaded. An over-under dial at the top of the cabinet indicates the scale balance. Each beam has a capacity of 500 lb and the total rated scale capacity is 800 lb.

The Hoist. The grain skip is raised to charge the hammer mill by two ¼-in steel cables from a double-drum hoist built especially for this project. The hoist shown in Fig. 5 is mounted at the top of two 3-in steel channels extending from floor to ceiling. It is a worm-and-gear hoist with a 20-to-1 reduction. The hoist was originally hand operated by means of a chain and hand wheel, but this was found to be difficult and time consuming and an electric drill motor was added to power the hoist.

The fulcrum bar upon which the supporting channels of the grain skip rotate also supports the outer end of the chute to the hammer mill.

Fig. 6 shows the 1¼-in electric drill motor used for the hoist. This source of power was selected rather than a regular gear-head motor because it could be used as the power source for another project in the dairy barn that occasionally requires the lightweight portable power offered by the drill motor.

The motor is held to the frame by four capscrews into the back of the motor housing. The Morse taper chuck has been replaced with a stub shaft terminated by one side of a coupling. The other side of the coupling is attached to a second short shaft held by two plain bearings. The sprocket on the free end of this second shaft is within the sheet metal guard. Power is transmitted to the hoist by roller chain. There are two switches on this drill. The trigger switch located on the handle is provided with a lock to hold it in the "on" position. A double-throw toggle switch for reversing the motor can be seen at the base of the upper handle just above the motor frame.

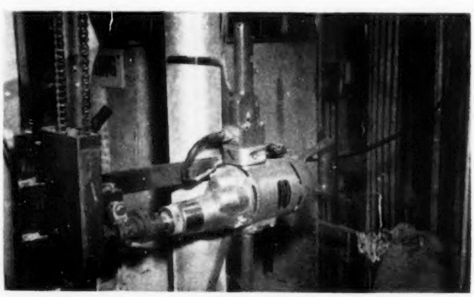


Fig. 6 Electric drill motor used for hoisting skip. Note reversing toggle switch mechanically linked to microswitch

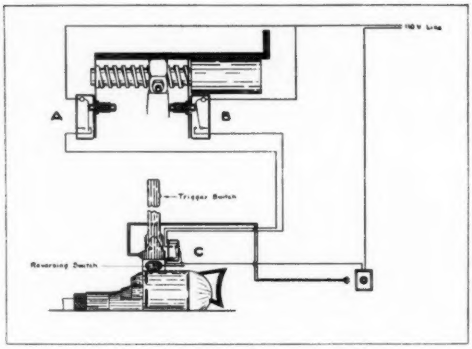


Fig. 7 Wiring diagram of limit control for protection to power hoist

A switching circuit was devised to limit the operation of the hoist to the travel of the grain skip about the fulcrum. A single-pole double-throw microswitch, part of the switching circuit, is mechanically linked to the motor reversing switch. The wiring diagram is shown in Fig. 7.

Also included in the limiting circuit are two other microswitches. These switches are operated by a rider on a screw attached to the drum shaft of the hoist. These switches open the circuit to the drill motor when the skip is raised to its limit or is lowered to its limit. In operation the switches function as follows:

The trigger switch on the drill is locked in "on" position. The reversing switch on the motor is thrown to raise the hoist. This operates the single pole double-throw microswitch C mechanically linked to it, and when switched to raise the skip causes current to flow through the upper limit microswitch A to the motor. When the skip is raised, the rider on the screw contacts the plunger of the upper-limit microswitch A and opens the circuit to the motor, thereby stopping the hoist. To lower the hoist the reversing switch on the drill motor is thrown and the microswitch C then allows current to flow through the lower limit switch B to the drill motor. When the skip is down, the rider contacts the lower-limit switch B and opens the circuit to the drill motor. With this circuit to the electric drill it is impossible for the hoist and allied equipment to become damaged. It also requires a minimum of the operator's time for raising and lowering the grain skip.

Hopper Storage Bin and Screw Conveyor. The terminal operation of the weighing and processing is the elevating of the mixed ground feed to the hopper-bottom storage bin. This bin consists of a V-shaped trough, the ends of which are vertical sheets of plywood and the bottom of which is made of corrugated aluminum sheet that serves as both sheathing and bin lining. A screw conveyor operates in the bottom of the V carrying the ground grain horizontally into the milking room where it flows into a small hopper-bottomed bin with scoop door at the base where the operator removes the grain for feeding. The automatic shutoff device for the screw conveyor is described in detail in an article by C. K. Otis, A. E. Domning, and S. J. Otis published elsewhere in this issue.

It has not been possible to operate the feed mixer at its rated capacity of 1000 lb; therefore, the batches processed have been much smaller than the 800-lb batch for which the other equipment was designed. At present the total weight of the finished ration is 510 lb and the skip is loaded to slightly less than one half its 800-lb capacity.

We have been interested in the time required to load the skip and grind the grain. Before the power was applied to the hoist it required 8.94 min to do this. This was reduced to 6.86 min with the use of the drill motor to hoist the box. To hoist the box by hand required 2.78 min and to hoist the box with power required only 0.70 min. The hard physical work was eliminated and the man's time in raising the skip was also cut to the few seconds necessary to start the drill motor.

The total time required to process a 510-lb batch and deposit it in the hopper storage bin on the second floor is 43.00 min. A great deal of time is consumed in mixing and in unloading the feed from the mixer to the blower in the hammer mill. Work in the future will be concentrated on improving the mixing operation or eliminating the need for the mixer. If successful, it will reduce the total time required by at least 60 per cent.

Automatic Shutoff for Grain Conveyor

(Continued from page 546)

motor is shut off, it will not start again until the start button is pushed by the operator. It was not considered desirable to have the operation completely automatic in keeping the bin full at all times since it would complicate the electrical control unnecessarily.

The make-up of the automatic shutoff switch is shown in cross section in Fig. 4 (page 546). It consists of a frame (1) that holds the switch in the correct position, a rubber boot (2) made from the neck of a toy rubber balloon that acts as a dust seal, a base plate (3) that holds the edges of this boot, an aluminum paddle (4) that catches enough grain to actuate the switch (7), a close-coiled tension spring (5) to join the switch arm to the paddle, and a housing (6) to cover the switch and the electrical connections. The spring joining the switch arm and the paddle provides a flexible connection that is stiff enough to hold the paddle in position and actuate the switch when grain strikes it and yet flexible enough so that it can bend backward without damaging the switch.

Potato Storage Research Results

By A. D. Edgar

AN INCREASE in lateral pressure of potatoes in storage is probably the cause of bin wall failures in winter rather than freezing as commonly supposed. The results of the tests were not as expected because most wall failures in potato bins have occurred as the bins were filled. Those occuring in midwinter usually have been attributed to freezing of the stored potatoes rather than to pressure.

Preliminary tests conducted during the winter of 1949-50 at the new Red River Valley Potato Research Center at Grand Forks, Minn., showed that average pressures of potatoes in winter storage are almost identical with those of ear corn in cribs. The lateral pressure at the 15-ft depth at the end of 21 weeks was about 92 psf, or about 10 per cent more than when the bins were filled. Downward pressures due to friction of potatoes on the wall were about 56 psf at the 15-ft depth after 21 weeks, about 20 per cent greater than at time of filling the bins.

Although attempts were made to compare mechanical injuries and losses from filling bins by various types of conveyors, slides, and chutes, the results were not significant because of difficulties encountered in adapting handling equipment to rotate filling of the bins. About 30,000 bu of potatoes stored in 23 bins, each 10 by 18 ft in size, were used in the 1949-50 tests.

Blower shell circulation planned for 1 cfm of air per 160 lb of storage capacity was compared with portable blowers for forcing air through the bins at the same rate. The higher static pressures in a thorough-circulation bin required four to eight times as much power when running as the shell circulation bin. The over-all power cost is about the same, however. Through circulation cools more rapidly but results in a greater bin temperature range and presents more problems in keeping ducts clean and adjusting for empty bins.

Research at the Grand Forks station is sponsored by the Red River Valley Potato Growers Assn., whose members have provided a 320-acre farm and buildings. The investigations are cooperative between the Association and member growers, the U.S. Department of Agriculture, and the North Dakota and Minnesota agricultural experiment stations, and are part of the research made possible by the Research and Marketing Act of 1946.

Thermocouple Switching Assembly for Recording Potentiometer

By V. H. Baker, R. B. Davis, Jr., and B. M. Cannon
ASSOCIATE MEMBERS ASAE

ONE of the most frequently measured variables in agricultural research is temperature. Often it is desirable to record the temperature of a number of different places at practically the same time. Recording potentiometers are now on the market that will record temperatures at 16 points or more. These instruments are now being used with thermocouples in many industries and elsewhere to record temperatures.

The object of this paper is not to discuss the use of thermocouples as a means of measuring temperature, but to present a method of adapting the 16-point recorder to record temperatures at 48 points. Some excellent information has been published on the use and construction of the thermocouple*,†. The authors have endeavored to utilize this information in designing a switching system for thermocouples in order to increase the measuring points of a 16-point recording potentiometer.

In some of the crop-processing and refrigeration studies that have been conducted at the Virginia Agricultural Experiment Station, it was necessary to record temperature automatically at more than 16 points. A switching arrangement was adapted to the 16-point M-H Brown Electronik recording potentiometer so that it would record temperatures at 48 points. The mounted instrument and controls are shown in Figs. 1 and 2. The circuit diagram for the modification is shown in Fig. 3. With this conversion, by using 48 thermocouples, temperatures at any one set of the following groups of thermocouples can be recorded: 1-48, 1-16; 9-24; 17-32; 25-40; 33-48, 41-48, and 1-8. With a given set of timing gears on the potentiometer, the combination of 16 points can be recorded in 8 min and 48 points may be recorded in 24 min. The recording potentiometer will record all of the above groups or combinations during one printing cycle, except that three cycles of the machine are required to print a total of 48 points.

By referring to Fig. 3, a complete cycle of the switching system for 48 points will be explained. Cam 1 is located in the potentiometer on a shaft which makes on revolution each time the instrument prints 16 points. This is a 180-deg cam and is used to operate a blade to microswitch (MS-7). With the blade riding on cam 1, MS-7 is caused to make and break the control circuit for relay K-7 each time the instrument prints 16 points. Relay K-7 is a double-pole, double-throw relay which controls the operation of the switching motor. Limit switches LS-1 and LS-2 are in the circuit of the switching motor to limit its rotation to one-half revolutions each time it starts. Referring to Fig. 3a, cam 1 in the position shown will relay the blade to MS-7 after the next point has printed on the potentiometer. When the blade to MS-7 is relayed, the control circuit in relay K-7 is opened, allowing it to form the motor circuit through the upper contacts of K-7. The motor will run long enough to turn its shaft one-half revolution. In so doing, limit switch LS-1 will be closed and LS-2 will be opened. As cam 1 continues to turn during the printing of the first 8 points of the cycle, the stage has been set for the operation of the motor when cam 1 closes MS-7. Fig. 3b shows the gear reduction from the switching motor to cam 1. The gears have a 1:3 ratio., i.e., cam 2 makes one revolution each time cam 1 makes three revolutions.

(Continued on page 552)

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

The authors: V. H. BAKER, associate agricultural engineer, Virginia Agricultural Experiment Station; R. B. DAVIS, JR., formerly associate agricultural engineer, U.S. Department of Agriculture; B. M. CANNON, research fellow in agricultural engineering, Virginia Polytechnic Institute, Blacksburg, Va.

*Lorenzen, Coby, Jr.: The Thermocouple in Agricultural Research, AGRICULTURAL ENGINEERING, June, 1949.

†Temperature, Its Measurement and Control in Science and Industry, Reinhold Publishing Corp., 1941.

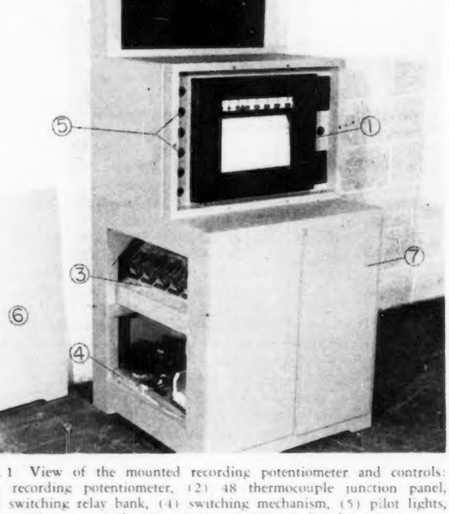


Fig. 1 View of the mounted recording potentiometer and controls: (1) recording potentiometer, (2) 48 thermocouple junction panel, (3) switching relay bank, (4) switching mechanism, (5) pilot lights, (6) cover panel, (7) storage compartment for charts, etc.

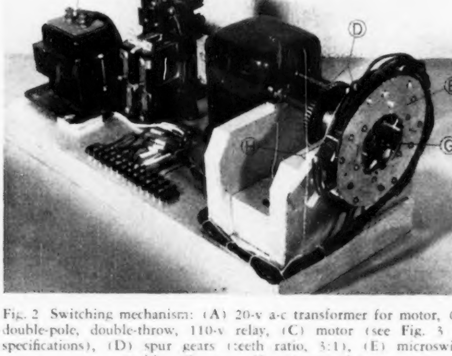


Fig. 2 Switching mechanism: (A) 20-v a-c transformer for motor, (B) double-pole, double-throw, 110-v relay, (C) motor (see Fig. 3 for specifications), (D) spur gears (teeth ratio, 3:1), (E) microswitch assembly, (G) cam, (H) microswitches

Thermocouple Switching Assembly

(Continued from page 550)

Fig. 3c shows the arrangement of 6 microswitches around cam 2, MS-1 to 6. These switches are located in such a manner that the blades actuating each are tangent to the "on" portion of cam 2 and are mounted at 60-deg intervals around cam 2 (Fig. 2). Each microswitch is in the control circuit of an 8-pole relay (K1-6) to which the thermocouple leads are connected. Cam 2 is positioned in such a manner that each time the motor turns one-half revolution it drops the blade of one microswitch, holds the blade of the next in circumferential order and picks up the blade of a third. Thus each time cam 2 makes one-half turn one relay is opened, another held and a third picked up. In the position shown when cam 1 opens MS-7, causing the motor to operate through LS-1, cam 2 will turn one-sixth revolution opening MS-4 and relay K-4, keeps MS-3 closed and closes MS-2. Thus, in this operation relay K-4 has been opened and relay K-2 closed with K-3 remaining the same. In the next operation, after 8 more points have been printed, relay MS-3 will be opened, MS-2 remains closed, and MS-1 will close.

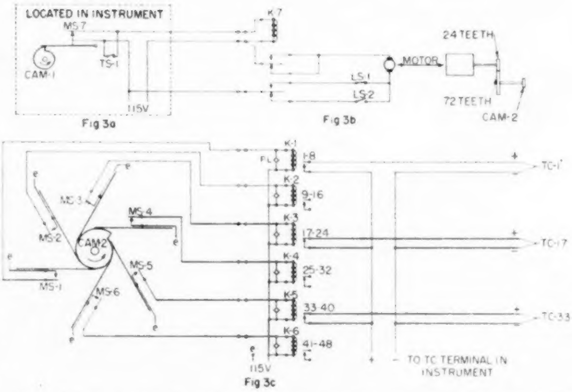


Fig. 3 Circuit diagram for adapting 16-point recording potentiometer to record temperature at 48 points. Cam 1, TS-1, MS-7 of Fig. 3a are located in instrument. Fig. 3b and c is the switching mechanism and relay bank. List of materials required: seven microswitches, MS-1 to 7; six 8-pole, single-throw, silver-contact, 110-v, a-c relays, K-1 to 6; on double-pole, double-throw, 115-v, a-c relay K-7; one 115-v or 20-v, a-c radiator motor valve, Minneapolis-Honeywell type V 205AX14C4 with built-in limit switches or equivalent; one toggle switch TS-1; six 115-v, a-c pilot lights; two 180-deg cams

An example of the thermocouple connections is shown in Fig. 3c. The switching relays K1-6 should be mounted in a dustproof compartment in order to protect the switching relay points. Here we see the thermocouple connections for thermocouples 1, 17, and 23. The positive side of thermocouple No. 1 is connected through K-1 to the No. 1 positive terminal of the instrument. The positive side of TC-17 is connected through K-3 to the positive terminal of the instrument. The positive side of TC-33 goes through K-5 to the same point in the instrument as TC-1 and 17. The negative sides of each of these three thermocouples are joined together and go to terminal No. 1 in the instrument. In like manner other thermocouples are connected so that the following schedule is obtained. The positive of TC-1 to 8 through relay K-1 to Nos. 1 through 8 on terminal strip in instrument; Nos. 9 through 16 through relay K-2 to terminal Nos. 9 through 16 in instrument; Nos. 17 through 24 through relay K-3 to terminals 1 through 8 in instrument; Nos. 25 through 32 through relay K-4 to Nos. 9 through 16 in instrument; Nos. 33 through 40 through relay K-5 to Nos. 1 through 8 on the terminal in instrument; TC-41 through 48 through relay K-6 to terminals 9 through 16. Thus, each terminal on the terminal block inside the instrument has three thermocouples attached to it. The positive leads of each thermocouple go through relays K1-6.

The operation of this modification is then as follows: After one block of 8 thermocouples has been printed, motion of cam 1 makes or breaks the circuit controlled by microswitch 7 opening or closing relay K-7. Each time relay K-7 opens or closes, the switching motor shaft turns one-half revolution or until it is stopped by the appropriate limit switch LS-1 or LS-2. When the shaft of the motor turns one-half revolution, cam 2 turns one-sixth revolution. In moving one-sixth revolution, cam 2 opens one microswitch, holds the next in order and closes the second in order, opens the relay controlling the thermocouples which have just been printed and closes the relay which selects the next block to be printed. This action is taking place while the relay between these two holds the thermocouples which are being printed. Thus, by cyclic operation, the several blocks of thermocouples are selected in order and printed on the chart.

When 48 points are being printed there will be three cycles of 16 points each. In other words, thermocouples Nos. 1, 17, and 33 will be printed as No. 1 on the chart. Nos. 2, 18, and 34 will be printed as No. 2 on the chart, etc. In order to distinguish one cycle of 48 points on the chart, it is generally desirable to place TC-1 or TC-48 in an ice bath or in a heated area where degrees F is above the points being recorded. In order to be able to further distinguish the various printed points on the charts, it is desirable to have successive thermocouples to record temperatures that are a few degrees apart.

When 48 points are to be printed, TS-1 (Fig. 3a) is in the off position. When any one group of 16 points is to be printed, i.e., 1-16; 9-24; 17-32; 25-40; 33-48; 41-48, 1-8, TS-1 is placed in the "on" position. This in effect shorts out MS-7 and allows two of the switching relays to be held in place that actuate the bank of 16 points desirable. Other combinations may be obtained by changing the spacing of the microswitches around cam 2 and changing the gear ratio of the driving motor.

This switching assembly has been used for three years and is reliable. The accuracy is as good as that of the 16-point potentiometer before the switching arrangement was added; however, several precautions and construction practices must be followed if satisfactory operation is to be obtained. All alternating-current wiring inside the switching compartment, Fig. 1, that comes within 2 ft of the thermocouple wires should be twisted or preferably placed in shielded cable. This is to prevent erratic operation of the thermocouples caused by currents set up by stray magnetic fields. All connections for each thermocouple between the panel board and instrument terminal should be carefully made and soldered in order to prevent corrosion and dust from interfering with the continuity of each thermocouple. The thermocouple switching relays should be located in a dustproof compartment. If it becomes necessary to clean the silver contacts of the switching relays, this should be done with a piece of heavy canvas and possibly carbon tetrachloride.

Men and Machines

THE error in our thinking is in attributing to the machine all the attributes of human beings or of God himself — the ability to choose between good and evil, to create, to destroy, to accomplish miracles. We have failed to understand that in and of themselves, machines are utterly without value. By themselves, they can accomplish absolutely nothing. They are still subject to the will of man.

A great many people in our country have failed to understand this important point, and as a result too many Americans have been and still are members of the cult of the machine, and worshipers at its altar. . . . Machines can do anything, we said to ourselves, and tried to glamorize our idols by streamlining them and painting them in bright and beautiful colors. — Dr. John A. Hannah, president, Michigan State College, in *Journal of Engineering Education*, September, 1951.

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Mechanical Feeding with Worksavers

By Ralph R. Parks
MEMBER ASAE

FEEDING beef animals, dairy cows and chickens requires work in grinding, mixing and distributing many different materials. To the engineer, it is just another materials-handling operation. To the farmer, it is a specialized job in which a man's training is most important. The farmer-engineer discounts many of the so-called "requirements" emphasized by farmers — even ignores many accepted engineering practices — and builds feeding equipment that may later become standard items of manufacture.

Take, for example, the mechanical poultry-feeder development. There are still many poultrymen that insist on using a wide variety of feeds, fed at different times of the day, so that mechanization under those conditions would be out of the question. Mechanization became possible when it was shown that a well-balanced, all-mash ration could be supplied. It comes as a uniform material that is consistent in its texture and can be handled in a machine now called the mechanical poultry feeder. A similar example exists in dry-lot feeding of steers. If it were necessary to feed long hay and concentrates separately, the present schemes for one-man, push-button feeding of 500 head in 20 min would not work.

Let's take a close-up look at a few of these work savers. In poultry feeding the gasoline engine and electric-powered feed carts do a good job in distributing feed in cage houses, collecting eggs, and hauling out fertilizer. When the electric cart is stored, it automatically connects its own charging current so as to be ready for the next trip. Incidentally, these carts not only do work on the ranch but make short trips to the shopping centers as well.

Feed to be used in these individual carts is quite often delivered in bulk bins that are carried from the mill on the beds of trucks equipped with hydraulic lifts. In that way the bins with their own legs are sealed at the mill and delivered in a matter of minutes. When they are empty, they are again picked up the same way and returned to the mill. The bins belong to the miller rather than the farmer.

Commercially there are at least six (6) chain feeders for poultrymen to choose from in the West. The first one, used during the war, consisted of a cable on which buttons were clamped for running through curved tubing. This made it easy for turns and going through vertical sections where there is a change in grade to be made. This system reminds one of the old chain pump idea for moving material; water in the case of the pump. Over horizontal runs, the bottom half of the tube serves as the base for the feed hopper. The top half of the button still runs above the feed level in the hopper and at times might distract some birds from eating.

Historically the second feeder of importance in the West was the over-and-under link chain unit which still is in many farm-assembled jobs. No. 45 has been a popular size link chain. These chain systems have been extended to 200 ft or more of run and are used for feeding two levels of caged birds or in supplying two height levels of feed hoppers in penned or open houses. One of these flat chain systems is turning smooth corners now. An adaptation of this chain idea was built by one poultryman that manufactured his own chain links, using 40-penny nails, bent for the links. On the heads he welded paddle scrapers. One of these units is still in operation used to feed 10,000 fryers in one room.

Another builder at first used spiral coils of light rod on the screw conveyor principle to move the feed short distances in hoppers. He has since given up the idea and replaced it with a reciprocating pusher-type length of sheet metal from which has been punched and bent scraper paddles. This unit is presently in operation on laying birds prior to moving them into cages.

Two specially built chains are being used in commercial feeders at the present time. One is an adaptation of the old flat chain which in this case can turn horizontally. It seems to be giving good service. The other unit has a specially manufactured link which moves with an intermittent forward push in the hopper. This unit has a few production engineering problems but on the whole seems to be giving good service. A newer development by this company is an oscillating hopper which walks the feed along the same as a straw rack moves material.

The whole mechanical feeder business for poultry seems to be in a state of flux, with dozens of ideas being tried. There are just two things of which we can be sure. Poultrymen want mechanical feeders even though *(Continued on page 556)*

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at Houston, Tex., June, 1951, as a contribution of the Rural Electric Division.

The author: RALPH R. PARKS, extension agricultural engineer, University of California, Davis.

(Left) This barn is equipped with a mechanical elevator for unloading chopped hay and silage • *(Right)* A combined shelter and mechanical feeder unit. With this unit 500 steers can be fed in 20 min

Mechanical Feeding

(Continued from page 554)

they have to make a number of concessions in their feeding plans and equipment to mechanize the operation. We can also be sure that with the inventive genius which is around every poultry ranch something better and more adaptable will be built with every change.

Bulk handling of feeds is being taken for granted in many areas. Some poultrymen are equipping to buy grain in carload lots. Others are pooling their orders for wholesale purchase of mashes. If the feed comes sacked, the sacks are quite often emptied on the spot and returned with the deliveryman. Unit costs continue to go down as mechanization and size of operation increases. It is not uncommon to find poultrymen with 10 to 13 thousand meat birds all in one large room, mechanically fed and automatically watered.

Now for a look at the progress being made in mechanical feeding of beef animals. Here again as with chickens a complete ration can be supplied, with certain concessions, to adequately finish steers for market and yet have a "push-button" operation that one man can handle.

MECHANICAL FEEDING OF BEEF ANIMALS

Much of the hay comes to the feedlot baled. This must be ground and piled ready for mixing with certain grains which are ground before mixing. Other items such as cottonseed cake and molasses complete the mix and are sent through a continuous spiral mixer with the hay. The final product is carried by a single No. 77 chain with cross flights along a 500-ft metal-lined feed bunk. It takes 20 min to feed 500 steers. The amount fed can be varied by the speed of the feeder chain. When the other lots of cattle are to be fed, a diversion gate on the feed spout can be turned to fill a feed truck.

Like the poultrymen, some of the cattlemen are satisfied with mechanically operated trucks or trailers to distribute feed to feed bunks. Many of these are arranged to feed out of one side only. However, some are arranged to pass down an alleyway and throw feed both ways at the same time. Some of the units have their own engines. Many use the power-take-off drive of the towing tractor. Still others are built on trucks and use the truck power take-off for driving the unloading apparatus. These units are usually unloaded with spiral conveyors laid lengthwise of the bed. The amount of feed unloaded is controlled with a slide gate at one end or the other of the bed. While the system of mechanically operated trucks and trailers is popular, most of the newer installations are using stationary mechanical feeders. Gabled roof sheds with concrete floors are built as an integral part of the chain feeder. *(Continued on page 558)*

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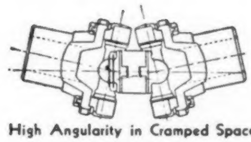

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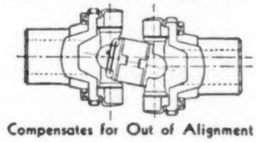

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Mechanical Feeding

(Continued from page 556)

One of our more recent cooperators, using a vertical-flue hay finisher, is equipping the main air tunnel with removable sides and top. This will facilitate loading a hay drag in the tunnel which will take the chopped hay to the grinder. In the field the long hay is picked up from the windrow with a "hay hog." This is a suction loader which gives the hay a rough chopping through the fan as the hay is blown into the van being towed behind. From the grinder the hay will go through the continuous mixer and out into a 500-ft drag-conveyor-equipped feed bunk. The hay shed over the finisher is 26 ft wide, 200 ft long, and 20 ft high. The fan is placed in the center for blowing half of the hay in the shed at one time. The vertical-flue system has the advantages over others of lower first cost, greater flexibility of operation, and less resistance to air flow for greater heights.

Now let's look at the dairy installations. In spite of the alarm by the sanitarians, many of our cleaner-dairies are feeding concentrates in milking barns from overhead hoppers. Most of the cows are fed according to production records so double-gate cutoffs are used to meter the feed to the individual cows. The milker pulls a rod connected to the gates to drop the required feed into the tub of the walk-through stanchion gate. Some of these overhead hoppers are filled with screw conveyors. Others are filled by drag conveyors, and still others are large enough to hold a week's feed supply and are filled direct by a bulk-feed delivery truck.

Hay is fed dairy cows in loafing barns, or shed, usually. The chopped hay is loaded into these "self-feeder" barns where a minimum of work is necessary to pull or push the hay to where the cows can easily reach it. In some instances the hay is stacked outside and portable bunks are placed around the stack so that as the stack becomes smaller, the portable bunks are pushed in to reduce labor in moving the hay for the bunks.

One of the more recent innovations in feeding chopped hay or silage (cut alfalfa brought in green) is to use a mechanical feeder similar to the beef-cattle unit. Except in this case a double chain with cross flights drag over the hay to fill a feed bunk some 4 ft deep. As the bunk fills the incoming hay is dragged over the filled bunk out to where it can drop down below the cross flight of the chain. In this manner it is only necessary to fill the feed bunk with hay every three or four days. Again a shed is built as a part of the feeder to protect the hay and cows from the weather.

An adaptation of this chain feeder has been installed in one dairy loafing barn so that a 2-hp conveyor system is used to fill the barn with chopped hay. The chain is high enough in the barn so that, with the slide doors closed, silage material can be handled with the same unit which takes it back to the silo at the far end of the barn.

Mechanical feeders appeal to poultrymen, cattlemen, and dairymen alike, as a means toward not only saving labor but for having better control over feeding operations. Mechanical feeders mean fewer mistakes for unskilled help, better working conditions for salaried workers, and larger operations with lower unit costs.

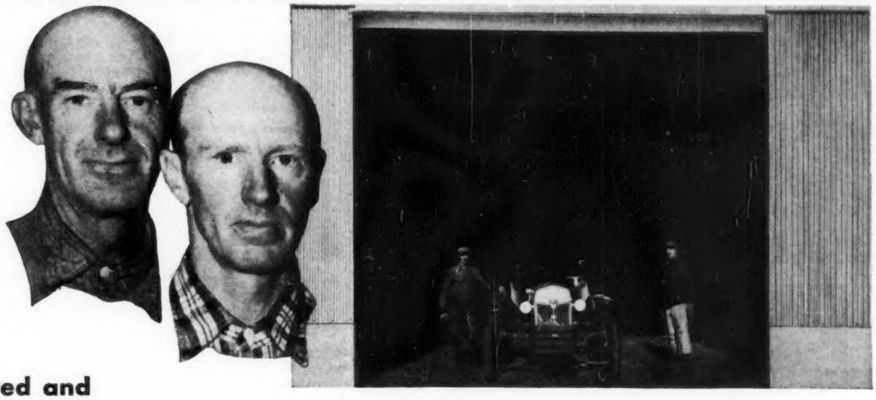
Even irrigated pastures are being replaced with alfalfa in some areas of the West because the cow is not considered to be such a useful or efficient harvester after all. Like the hen, her roaming days might be numbered. Engineering is making it possible not only to feed and milk her mechanically, but also to remove her milk and by-products from the dairy by bulk methods using a minimum of hand and back labor.

German AE Society at New Address

ACCORDING to word received from the Secretary, Otto Schnellbach, the Max-Eyth-Gesellschaft zur Forderung der Landtechnik (the German society of agricultural engineers) transferred its headquarters from Eubigheim to Frankfurt/M. The new address is Frankfurt/M-Nied, Elsterstrasse 57, Germany.

The Kuratorium fur Technick in der Landwirtschaft (KTL) has also been moved from the Siesmayerstrasse 6 to Eschersheimerlandstrasse 10 at Frankfurt/M.

Members of ASAE in other countries are invited to call on the secretary of the M-E-G when traveling in Germany.



NEWS SECTION

ASAE Meetings Calendar

October 14—WASHINGTON (D.C.) SECTION, Room 6962, South Bldg., USDA, Washington

October 18 and 19—PENNSYLVANIA SECTION, William Penn Hotel, Pittsburgh, Pa.

October 25-27—PACIFIC NORTHWEST SECTION, Pullman, Wash., and Moscow, Ida.

October 26—IOWA-ILLINOIS SECTION, Peoria, Ill.

October 27—OHIO SECTION, Ives Hall, Ohio State University, Columbus

October 30—MINNESOTA SECTION

November 3—GEORGIA SECTION, Barrow Hall, University of Georgia, Athens.

November 16—OKLAHOMA SECTION, Student Union Bldg., Oklahoma A. & M. College, Stillwater

December 7 and 8—ALABAMA SECTION, Gadsden, Alabama.

December 17-19—WINTER MEETING, The Stevens, Chicago, Ill.

February 4-6—SOUTHEAST SECTION, Atlanta Biltmore Hotel, Atlanta, Ga.

June 16-18—ANNUAL MEETING, Hotel Muehlebach, Kansas City, Mo.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to A.S.A.E., St. Joseph, Michigan

Longhouse New Chairman of NA Section

DR. ALFRED D. LONGHOUSE, head, agricultural engineering department, West Virginia University, was elected the new chairman of the North Atlantic Section of the American Society of Agricultural Engineers at the regular yearly meeting of the Section held August 27-29 at Atlantic City, N. J. The new vice-chairman of the Section is Rollo H. Wileman, agricultural engineer in the research and development department of United Cooperatives Laboratory at Ithaca, N. Y. Morris H. Lloyd, agricultural engineer, Niagara Mohawk Power Corp., Buffalo, N. Y., was re-elected secretary of the Session.

With one possible exception, the attendance at this year's meeting of the Section was the largest in its history.

30th Country Life Conference

"THE people on the land are more important than any product they create" aptly keynoted the 30th Annual Conference of the American Country Life Association held at the University of Illinois, Urbana, September 18-20, 1951.

The American Society of Agricultural Engineers was represented at the meeting by Deane G. Carter, professor of farm structures, University of Illinois, who was appointed by Society President Stanley Madill as the Society's official delegate. Several members of ASAE attended one or more sessions.

It was a refreshing experience, Mr. Carter reports, to attend a conference where the primary emphasis was on the independence and well-being of the family as contrasted with the purely technical, professional, and economic problems that generally dominate in group meetings.

The conference theme was "Home and Community Responsibilities in a World of Tension." The consensus was that what we do to relieve tensions must be done largely by actions within the home and community. Problems discussed ranged from those of farm and public policy to rural education, well-being, recreation, and freedom of action.

Primarily the conference served as a stimulus and a guide to action by rural leaders, social scientists, teachers, and pastors. The impression was gained, however, that the sciences of engineering, production, and management must contribute not only to profit and abundance, but also to the translation of resources into improvements in the rural home, church, school and community.

Agricultural engineers can take satisfaction in the recognition accorded to mechanization, conservation, electric service, and the farm home as influences for the betterment of farm living.

The American Country Life Association's objective is to encourage "all methods of rural improvement to bring about a richer and fuller life for rural people. Its field of interest includes the rural home, the school, the church, improvements in rural health, rural recreation, rural culture and rural community building."

Irrigation Working Conference

ON SEPTEMBER 5 and 6 at Auburn, Ala., the Southeast Section of the American Society of Agricultural Engineers sponsored what it called an "Irrigation Working Conference." *(Continued on page 562)*

DUCTILE IRON

provides

IMPROVED FARM IMPLEMENT PARTS

with

Superior Resistance to Abrasion and Breakage

DUCTILE IRON is a cast ferrous product that combines the *process advantages* of cast iron with many of the *product advantages* of cast steel.

In less than two years, ductile iron has attained wide acceptance because it offers excellent castability, high mechanical properties and good machinability. Parts cast in ductile iron show superior strength, high modulus and resistance to shock.

AGRICULTURAL APPLICATIONS INCLUDE: Tail wheel mounting bracket, hay baler knotter drive (lower gears), hay baler ring gears, gear carriers, worm and wheel, rear axle housing, plow spring release hitch.

ADDITIONAL AGRICULTURAL APPLICATIONS EITHER ON AN EXPERIMENTAL OR PRODUCTION BASIS AT PRESENT TIME: Tractor clutch plates, tractor transmission housing, front axle supports, implement sprockets, chilled plow shares, mower guards, tractor pulleys.

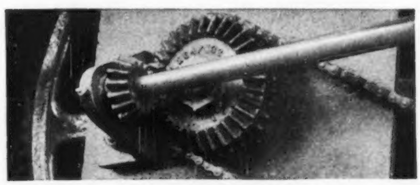
AVAILABILITY—Send us details of your prospective uses, so that we may suggest a source of supply from some 100 authorized foundries now producing ductile iron under patent licenses. Request a list of available publications on ductile iron... mail the coupon now.

EMBLEM OF INCO SERVICE

Plowshares cast in ductile iron, with edges chilled for hardness, have proved not only tougher than cast iron, but better than steel in wearing qualities. When tested in fields containing more rocks than soil, plows fitted with ductile iron shares were thrown right out of the ground when they struck rocks... yet the shares came through without breaking or bending.

Otaco Limited, of Orillia, Ontario, Canada, market the ductile iron components illustrated under the registered trade name of "Ductalloy."

This tractor spring release hitch, with high yield strength, is only one of many farm equipment components improved when cast in ductile iron.



The ductile iron bevel gears used on hay balers shown here were produced to provide high wear resistance and toughness.

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NEWS SECTION *(Continued from page 560)*

At the opening session on September 5, F. A. Kummer, head, agricultural engineering dept., Alabama Polytechnic Institute, presided as chairman, and the group was welcomed by E. V. Smith, dean of the school of agriculture and director of the Alabama Agricultural Experiment Station. The remainder of the session included talks on the interest of the extension service and of the Soil Conservation Service in irrigation, the ground water situation in the Southeast, surface impoundment of water for irrigation and conservation, and rooting habits of Southern field crops.

The afternoon of the first day was devoted to field demonstrations and display of irrigation equipment including several different types of sprinkler systems, pumps, engines, perforated pipe and gated pipe.

A. W. Cooper, U.S. Soil Conservation Service, presided as chairman at the forenoon session on September 6. The program included talks on soil physical characteristics as they affect irrigation, evapo-transpiration versus other methods for determining when to irrigate, and several short summaries on irrigation research results from representatives of 12 states of the Southeast.

The chairman of the afternoon session was George M. Renfro, Jr., U.S. Soil Conservation Service. The program opened with a panel discussion on power for irrigation purposes, including both electricity and internal-combustion engines. This was followed by another panel discussion on the subject of irrigating pastures, row crops, and horticultural crops. The participants in this discussion were representatives of the Alabama and Tennessee agricultural experiment stations.

Michigan Section Meeting October 27

THE next meeting of the Michigan Section, ASAE, will be held in the auditorium of the Agricultural Engineering Building on the Michigan State College campus, East Lansing, starting at 9:30 a.m., Oct. 27.

The program will include two formal talks, one on agricultural engineering in defense mobilization by W. M. Carleton, Michigan State College, and another on instrumentation and controls in agriculture by Waldo H. Kliever, Minneapolis-Honeywell Regulator Co. A third talk on the use of plastics in agriculture is also on the preliminary program. The Section will also discuss a proposal to affiliate with the Engineering Society of Detroit. Luncheon reservations should be arranged direct with Section Secretary R. G. White, 222 Agricultural Engineering Bldg., Michigan State College, East Lansing.

Iowa-Illinois Section Meeting October 26

"FUELS for Food Production in Event of War" is the theme for a meeting at Peoria, Ill., October 26, sponsored jointly by the Iowa-Illinois Section of the ASAE and local sections of the ASME, SAE, ACS, and ASM. The Caterpillar Tractor Co. and the Northern Regional Research Laboratory will be hosts to the meeting.

An 8-hour program, from 1:00 to 9:00 p.m., will open with optional tours through the new Caterpillar engine factory and the Northern Regional Research Laboratory.

These tours will be completed by midafternoon and be followed by additional optional features. At 3:30 at the Caterpillar Theater a motion picture, "Power for Protection," will show applications of equipment for gully control, pond building, terracing and other agricultural purposes. It will be followed at 4:15 by an illustrated lecture on "Economies of Construction Equipment on Farms." This is to be presented by M. O. Crowe, of the Caterpillar sales development division.

An abbreviated tour of the Caterpillar engine factory will also be available during the latter half of the afternoon for those who take in the Laboratory tour at the earlier period.

A short talk on Caterpillar restaurant operations will be given at 4:45 by Fred R. Jolley, manager of the community relations department.

L. J. Fletcher (past-president of ASAE), vice-president, Caterpillar Tractor Co., will serve as moderator for the evening program starting at 6:30. It will open with an address on "Fuels for Civilian Use in Event of War," by Thomas L. Apjohn, assistant director of refining, Petroleum Administration for Defense.

A panel to follow will include C. G. A. Rosen, consulting engineer, Caterpillar Tractor Co., discussing "Burning Petroleum Fuels in the Agricultural Internal Combustion Engine in Time of War"; E. J. Stirniman, consultant on agricultural sales, Caterpillar Tractor Co., introducing the question "How Will War Fuels Influence Animal Power?"; and two representatives of the Northern Regional Research Laboratory covering "Emergency Fuels from Agricultural Residues" and "Alcohol as a War Time Fuel." The session will conclude with a question period.

Further details on this meeting will be announced by letter to members of the Iowa-Illinois Section. ASAE members from other states who may plan to attend should register their intention, showing which of the optional afternoon programs they plan to attend, whether they will want to eat the evening meal at the Caterpillar Cafeteria, and whether or not they will attend the evening session. This information should be mailed not later than October 20, to F. P. Hanson, agricultural engineer, Caterpillar Tractor Co., Peoria 8, Ill.

Cotton Mechanization Conference

THE fifth Annual Beltwide Cotton Mechanization Conference, sponsored by the National Cotton Council of America and cooperating agencies, will be held November 8 and 9 at Chickasha, Okla. The conference will bring together several hundred top leaders of the farm equipment industry, the land-grant colleges of the 18 cotton states, the U.S. Department of Agriculture, and the cotton industry, to discuss problems which must still be solved before the maximum practical mechanization of cotton farming can be attained.

The theme of the 1951 conference is "Cotton Mechanization — Vital to Defense Production." The Conference will review progress in the past year and give special attention to the stepped-up need for an expansion of mechanization created both by the defense needs and by the growing shortage of farm labor. A demonstration of completely mechanized cotton farming at the Chickasha Substation of the Oklahoma Agricultural Experiment Station will be a feature of the second day of the conference. Information on housing, reservations, etc., may be obtained by writing National Cotton Council, P.O. Box 18, Memphis 1, Tenn.

APPLICANTS FOR ASAE MEMBERSHIP

The persons listed below have applied for admission to membership, or for transfer of membership grade, in the American Society of Agricultural Engineers. Members of the Society who wish to commend or object to any of these applicants, should write the Secretary of the Society at once. If no objections have been received in the meantime, these applicants will be voted on by the Council after November 15, 1951.

ABELT, JOHN F.—Sales engr., Chain Belt Co., Milwaukee, Wis.

ARNOLD, LOREN G.—Design draftsman, Minneapolis-Moline Co., Moline, Ill.

BERGSTEIN, NORMAN M.—Engr., soil conservation service, Israel Department of Agriculture, Tel Aviv, Israel. (Temporary address: c/o Bergstein Co., Duluth, Minn.)

CHAMBERLAIN, ADRIAN R.—Graduate res. asst. in agr. eng., Washington State College, Pullman.

DE MIRANDA CARDOSO, ENO—Agr. engr., Refinadora Paulista S. A.

DONALDSON, MARION P.—Dist. rural service engr., Alabama Power Co., Birmingham, Ala.

DOOLITTLE, WARREN A.—Asst. field engr., Platte Valley Public Power and Irr. Dist., North Platte, Nebr.

DUMM, EUGENE H.—Trainee, International Harvester Co., Fort Wayne, Ind.

GRAUERHOLZ, WALDEAN W.—Trainee, John Deere Waterloo Tractor Wks., Waterloo, Iowa.

HENRICKSON, CHARLES T.—U.S. Air Force, Scott AFB, Ill.

HERMSMEIER, LEE F.—Agr. engr., Soil Conservation Service, USDA, Rochester, Minn.

HUTCHINSON, SHELDON C.—Agr. engr., Brosius Eng. & Supply Co., Frederick, Md.

JOENS, ARNOLD C.—Agr. pump tester, Southern California Edison Co., Los Angeles, Calif.

LARSEN, ARDELL M.—Sales engr., Uhl Co., Minneapolis, Minn.

LAUDENCIA, PEDRO N.—Jr. agr. engr., Bureau of Plant Industry, Manila, P. I.

MACBRIDE, ARTHUR H.—Sales engr., Allied Equipment Co., Fresno, Calif.

MARCOTTE, STANLEY B.—Trainee, Massey-Harris Branch Office, Denver, Colo.

MCKILLOP, ALLAN A.—Lecturer and asst. spec. in agr. eng., University of California, Davis, Calif.

NATARAJAN, K.—Asst. agr. engr., Madras Department of Agriculture, Tanjore, Madras, India.

PEDERSEN, JOHN H.—Graduate student, Iowa State College, Ames, Iowa.

PRATT, GEORGE L.—Acting inst. and exp. sta. engr., North Dakota Agricultural College, Fargo, N. D.

RION, RICHARD M.—Service dept., Harry Ferguson, Inc., Detroit, Mich.

SALVA, LADDIE G.—Civil engr. trainee, Bureau of Reclamation, USDI, Sacramento, Calif.

SCHNUG, WILLIAM R.—Agr. sales engr., Eastern Div., The Ohio Power Co., Steubenville, Ohio.

SMITH, WILLIAM B.—Agr. engr., Soil Conservation Service, USDA, Little Rock, Ark.

STOOKEY, DANIEL—Designer-draftsman, Minneapolis-Moline Co., Moline, Ill.

TAYLOR, CHARLEY S.—Ext. agr. engr., New Mexico College of Agriculture, State College, N. M.

WILLIAMS, HERMAN F.—Asst. prof. of agr. eng., University of Missouri, Columbia, Mo.

TRANSFER OF GRADE

WHITAKER, ROBERT W. — U.S. Air Force, Wright-Patterson Air Force Base, Dayton, Ohio. (Associate Member to Member)

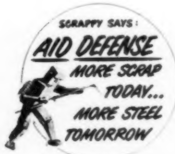
This nearly empty Armco scrap yard is typical of the serious situation throughout the steel industry. Help get in the scrap.

Steel mills need farm scrap

The steel industry desperately needs farm scrap. With production headed for 117 million tons, the industry needs 5 million tons more scrap than was required in 1950.

About one-third of this sorely needed scrap is on farms—50 million dollars' worth! Farm scrap is especially desirable. It takes heavy stuff to satisfy the appetite of big furnaces trying to make enough steel for growing defense and civilian needs.

Farm equipment manufacturers are organizing plant scrap committees. County agents and other farm advisers are alerting farmers and helping them check worn-out equipment and machinery. *Your* co-operation is needed right now to meet defense requirements and produce steel for enough farm machinery to do the job of feeding millions here and abroad. To serve your own interests, get into the scrap for scrap!



ARMCO STEEL CORPORATION

MIDDLETOWN, OHIO, WITH PLANTS AND SALES OFFICES FROM COAST TO COAST
THE ARMCO INTERNATIONAL CORPORATION, WORLD-WIDE

PERSONALS OF ASAE MEMBERS

James W. Crofoot is presently on leave from this position with GLF Farm Supplies to serve as chief of the dairy and barnyard equipment branch, Agricultural Machinery and Implement Division of the National Production Authority. In this work he is serving in about the same capacity that he did during World War II.

George B. Hill resigned some months ago as chief engineer of the New Holland Machine Division of The Sperry Corp., and is now director of engineering of the New Idea Div. of Avco Mfg. Corp., Coldwater, Ohio. Mr. Hill is currently the chairman of the Power and Machinery Division of ASAE.

James A. Luscombe is engineer-in-charge, Oklahoma Cooperative Ginning Investigations, a joint project of the U.S. Department of Agriculture and the Oklahoma Agricultural Experiment Station and is located at the substation at Chickasha.

K. L. Magee, for several years chief engineer of the Burlington (Iowa) Works of J. I. Case Co., was recently transferred to the Company's Rockford (Ill.) Works in the position of chief engineer.

Robert C. Mueller, until recently in charge of sales promotion for the Wade Rain Sprinkler Irrigation Div., of R. M. Wade & Co., Portland, Ore., was recently appointed chief of the irrigation section, agricultural machinery and implement div., National Production Authority. In this position Mr. Mueller will be responsible for presentation of the sprinkler irrigation industry's requirements for material under CMP and for the formulation of policies necessary to effectuate equitable distribution of materials throughout the industry. His functions extend both to the flood and sprinkler irrigation industries.

Kurt Nathan has resigned as assistant professor of agricultural engineering at the National Agricultural College, Doylestown, Pa., to accept appointment as a research associate in agricultural engineering at Rutgers University.

Russell R. Poynor, agricultural engineer, farm practice research division, International Harvester Co., and currently chairman of the ASAE Soil and Water Division, was elected a member of the Board of Governors of the National Farm Chemurgic Council, at that organization's annual conference at Cincinnati last October.

D. C. (Dave) Sprague has resigned as professor of agricultural engineering at the Pennsylvania State College, to accept a position with G. L. F. Farm Supplies, Ithaca, N. Y., as a buyer specializing in irrigation and electrical equipment.

Louis H. Temple, Jr., recently joined the organization of the Butler Mfg. Co., Kansas City, Mo. He was formerly assistant instructor in agricultural engineering at the University of Missouri while completing requirements for his master's degree.

Miles H. Tuft is now employed as chief research and development engineer of the Hardy Mfg. Co., and is located at Huntington Park, Calif.

Eric B. Wilson is on leave as extension agricultural engineer, Montana State College, to devote the next year or two to agricultural engineering work in the Philippines, under an arrangement by the Economic Cooperation Administration.

Thomas R. C. Rokeby has joined the agricultural engineering staff at South Dakota State College. He will engage in teaching and research in farm structures. He was previously a graduate student in rural sanitation at Ontario Agricultural College.

J. H. Levin is co-author of "Grading Apples in the Orchard, published in Michigan Agricultural Experiment Station Quarterly Bulletin, May, 1951.

PROFESSIONAL DIRECTORY

RATES: Announcements under the heading "Professional Directory" in AGRICULTURAL ENGINEERING will be inserted at the flat rate of $1.00 per line per issue; 50 cents per line to A.S.A.E. members. Minimum charge, four-line basis. Uniform style setup. Copy must be received by first of month of publication.

NECROLOGY

LOUIS A. GILMER, chief engineer at the Charles City (Iowa) plant of The Oliver Corp., passed away unexpectedly of a heart attack at his home in Charles City, September 6. He was 48 years of age.

Born at Alamosa, Colo., Mr. Gilmer studied ceramic engineering at the University of Illinois for two years and obtained additional training in metallurgy, mechanical engineering, and internal-combustion engineering in night school and extension courses. Following early experience as a draftsman on pumps and air compressors, and on steel mill layout, he established a connection with the Buda Co., in which he progressed rapidly from draftsman and designer to assistant chief engineer of the diesel engine division. He gained further experience with the International Engineering Corp. as chief engineer on diesel injection equipment, and as design engineer on diesel engines with Baldwin-Southwark Corp.

His first contact with the agricultural engineering field was in 1932, when he joined the John Deere organization as a design engineer on tractor engines. In 1934 he went to Charles City plant of The Oliver Corp., as assistant chief engineer and since 1942 had been chief engineer of that plant. He was a member of ASAE and the Society of Automotive Engineers. He has also been a member for several years of the engineering advisory committee of the Farm Equipment Institute. He was also active in the Grace Episcopal Church, the Elks, and Rotary. Surviving are Mrs. Gilmer, a son, a daughter, and two sisters.

• • •

BEN DUNCAN MOSES, professor emeritus of agricultural engineering, University of California, passed away September 7. He was 68 years of age.

Professor Moses was stricken about a month ago while on vacation in the Sierras and was taken to a San Francisco sanitorium where he remained until his passing. He had been a member of the University staff in Davis for the past 29 years.

A native of New Mexico, he attended the University of California at Berkeley, receiving the B.S. degree in mechanical engineering in 1909. His experience in industry included work in the experimental department of the Holt Mfg. Co. of Stockton and as southwestern branch manager of the Yuba Mfg. Co. at Dallas, Texas. He joined the University of California staff at Davis in 1922 as assistant professor, retiring in 1950 as professor emeritus. For the past year he had been living in Carlsbad, Calif., where he taught in the Army and Navy Military Academy.

Professor Moses was the author of more than 40 publications, including university bulletins and technical papers, and was co-author of a college text on gas engines and tractors now in press.

He was an outstanding teacher, giving courses in farm power, on which he was an international authority. For 25 years he was secretary to the California Committee on the Relation of Electricity to Agriculture and was responsible for much of the progress in electrifying California farms. In 1950 he received a special plaque in recognition of his services to this committee.

In addition to his professional duties, Professor Moses found time to assist in many civic projects. One of his chief outside interests was working with the Boy Scouts. For many years he was Scout Master in Davis. For meritorious service to the youth organization, the Golden Empire Council awarded him the Silver Beaver in 1947. In the same year the City of Davis named him its outstanding citizen.

He was a leader in the organization of First Church of Christ, Scientist, in Davis, of which he was a member. Other affiliations included the Rotary Club of Davis, Sigma Xi (honorary scientific society), the American Society of Agricultural Engineers. He was a past-chairman of the ASAE Rural Electric Division.

Surviving are his wife, Mrs. Lillian Moses; one daughter, Mrs. William J. Hurley of Delano; two sons, Benito of Philadelphia, Pa., and Harold of Carlsbad, Calif.; six grandchildren, and two brothers, both of New Mexico.

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LOUIS A. PARADISE, research engineer, product research department, Deere and Co., passed away August 2 at the age of 72.

Born at Aurora, Ill., he graduated in mechanical engineering at Armour Institute of Technology in 1906. Shortly following his graduation he joined the John Deere organization as a draftsman at the plow works.

Moving up through positions as assistant master mechanics, master mechanic, superintendent of the harvester works, superintendent of the Waterloo tractor works, superintendent of experiments at the harvester works, and assistant manager of that plant, he was made manager of the plant in 1934 and continued in that capacity until 1946. At that time he was transferred at his own request to less arduous duty in the product research department.

He was a veteran of the Spanish-American War, a member and former trustee of the First Congregational Church in Moline, a former member of the Board of Education of Moline, and affiliated with various engineering societies, the Moline Association of Commerce, the Moline After-Dinner-Club and Martin Lodge of Masons in Waterloo, Iowa. A member of the ASAE since 1925, he frequently attended meetings of the Power and Machinery Division and the Iowa-Illinois Section.

He is survived by Mrs. Paradise, two sons, a daughter, a sister, and three grandchildren.

• • •

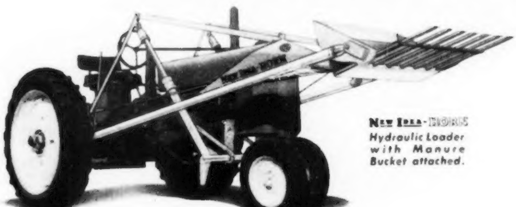
LAURENCE EDWIN SINCLAIR, farmer, Calipatria, Calif., passed away August 22 at the age of 68. He was there only for a routine physical checkup when he suffered a heart attack.

A native of Ashland, Ill., he attended the University of Illinois and received his bachelor's degree in agriculture in 1907. He moved to California shortly thereafter and made himself one of the leading farmers in the Imperial Valley. Locating in the Calipatria area in 1915, he reclaimed, leveled, and put into production 320 acres of desert land. His operations gradually expanded to more than 3,000 acres. A leader in the adoption of improved practices and the application of engineering methods to large-scale farming operations, he was the first to use tile drainage in the Imperial Valley, the first there to practice deep plowing, and first in the Valley to grow (*Continued on page 570*)

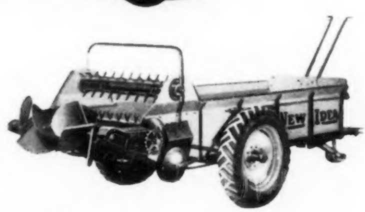
Make "PAY DIRT" Pay!

with NEW IDEA

NEW IDEA equipment helps farmers get TOP VALUE from manure



New Idea-Horn Hydraulic Loader with Manure Bucket attached.



12-A Tractor Spreader. 85 to 90 bu. cap.

Manure is strictly a money crop. Based on its ability to increase yields, it's worth around $2.00 per scoop . . . or from $5 to $10 a ton depending on how well it's managed and applied.

That's why it's so important to farmers to get their manure loaded and onto the field as quickly and efficiently as possible . . . and that's where New Idea enters the picture. The New Idea-Horn Hydraulic Loader (now distributed by New Idea dealers) takes all of the dread and drudgery out of the loading job . . . speeds the work. The New Idea Spreader gives the thorough pulverization and even spreading that makes for bigger crops. Together, this team helps farmers everywhere realize top value from their manure.

You'll want to know more about the outstanding features of these machines, so why not write us today.

14-A Tractor Spreader 60 Bu. Cap.

10-A Horse or Tractor Spreader 70 Bu. Cap.

NEW IDEA FARM EQUIPMENT

One NEW IDEA after another for better farming since 1899

NEW IDEA
FARM EQUIPMENT COMPANY
SUBSIDIARY AVCO MANUFACTURING CORPORATION
COLDWATER, OHIO, U.S.A.

NECROLOGY *(Continued from page 568)*

winter peas. He became the largest grower of winter peas in the United States.

In addition to actively managing his own farm he was a director of the Imperial County Farm Bureau, the Imperial Grain Growers Association, and the Producers Livestock Marketing Association, and an active member of the Calipatria Community Church. He had maintained membership in ASAE since 1940 by way of keeping up-to-date on engineered equipment and its application to farming operations. He is survived by Mrs. Sinclair, a daughter and two grandchildren.

• • •

Andrew Weiss, consulting engineer, passed away September 2 at Mexico City at the age of 84. An immigrant from Austria, he graduated from the Colorado School of Mines in 1899, and for the next several years served on its faculty as assistant professor of mathematics and surveying.

In 1903 he became associated with the U.S. Reclamation Service, and he was, in turn, assistant engineer and engineer in charge of construction, interstate division, North Platte project; manager of the North Platte project, and assistant director of reclamation economics.

In 1926 he was a member of a party of engineers invited to Mexico to plan and construct irrigation works for the newly established Mexican National Commission of Irrigation. Until 1932 he served as resident engineer on supervision and construction of the Don Martin Reclamation Project. From 1930 to 1932 he also served part time as engineer on the Conchos Irrigation Project. In 1932 he accepted an invitation to serve as consulting engineer for the National Commission. In 1938 he was appointed chief of the technical consulting department of the Commission, and was still active in that capacity at the time of his passing.

For short periods in 1939 and 1940 he returned to the United States as consulting engineer and expert witness to the U.S. Department of Justice in proceedings on water rights on the North Platte River. In 1946 he was again called to the United States as a consultant on repairs to dam facings on the Santee-Cooper Project. He also served as a consultant on dams and tunnels for a number of works constructed by the Mexican National Commission of Electricity. In spite of his advanced age and illness he had, only a week before his passing, made an inspection visit to the Guadalupe Dam.

On hearing of his serious illness, the President of Mexico resolved that two of the major works to which he had contributed most notably and directly, the diversion dam of Ojo Caliente and the main canal of Conchos, should be given his name as memorials to his life and work. He had also been honored in 1949, the 50th anniversary of his graduation from the Colorado School of Mines, with its medal for distinguished achievement in the fields of mineral engineering, and by election as an Honorary Member of the American Society of Civil Engineers. He had been a member of ASAE since 1926. His professional standing is further evidenced by the fact that he was highly recommended for membership by the late Drs. Elwood Mead and Samuel Fortier. He is survived by two daughters residing in Denver.

Technical Aid

(Continued from page 535)

rights and values inherent in the individual has not yet been reconciled with a corollary concept of our obligations and responsibilities to future generations.

Overpopulated areas cannot be helped by merely removing some of the present privation inhibitions to population growth, and compounding the future problem. They can only be helped by substituting for privation some positive moral or cultural inhibition to unbounded population increase.

In the name of humanity we would not deny help where it can be given and utilized effectively. The question is where and how, and what types and concentrations of technical aid may be most effective? How can we make our help real rather than an expensive gesture with probable future repercussions?

Considerations include not only the resources, people and miseries of the present, but the prospective need for help in the future, and the maintenance of our capacity to help.

Undoubtedly there are some countries in which the undeveloped resources are large in proportion to the population; where improved technology can enable production increases to outrun population increases; where some of the resulting capital gain may be channelled in the direction of better living and more widespread education.

These, we believe, are the countries where our technical aid in agricultural engineering may prove most helpful, and professional service most satisfying. At least that may be true until something other than direst privation becomes the controlling factor on population pressures in some other countries.

Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. The Society does not investigate or guarantee the representations made by parties listed. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request. "Agricultural Engineer" as used in these listings, is not intended to imply any specific level of proficiency, or registration, or license as a professional engineer.

NOTE: In this bulletin the following listings still current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated:

POSITIONS OPEN: JULY—O-299-527, 301-529, 305-531. AUGUST—O-282-532, 320-533. SEPTEMBER—O-330-534, 340-539, 353-540, 354-541, 355-542, 356-543.

POSITIONS WANTED: MAY—W-252-53, 253-54, 276-56, 277-57. JUNE—W-264-58, 260-59, 232-60, 261-62, 280-63, 263-65. JULY—W-205-66. AUGUST—W-310-69, 315-70, 292-71. SEPTEMBER—W-331-72, 333-73, 334-74.

NEW POSITIONS OPEN

CHIEF ENGINEER to initiate and supervise manufacture of farm implements by steel fabrication in a plant to be established at Allahabad, India. Must know methods of working steel, particularly shearing and stamping parts, tool and die making, welding, etc. Must be active Protestant Christian prepared to work and live with a mission group. Consideration given to vigorous retired technical executive in steel fabrication. Business to be set up as a profitable investment for endowment funds of the Allahabad Agricultural Institute, and to contribute to the work of the Institute in other ways. Salary open. O-401-544

AGRICULTURAL ENGINEER for testing and research in midwestern plant of a large farm equipment manufacturer. BS or MS deg in agricultural or mechanical engineering or equivalent. Previous experience desirable but not essential. Work requires pleasing personality and ability to meet people. May require considerable travel. Salary open. O-396-545

NEW POSITIONS WANTED

DESIGN, development, research, or writing in power and machinery or farm structures field with manufacturer or processor anywhere in U.S.A. BS deg in agricultural engineering June, 1951, Purdue University. Farm background. Maintenance work in a small screw factory 11 weeks. Part time electrical wiring during school vacations. War enlisted service in army one year. Married. Age 25. No disability. Available now. Salary $3600. W-377-75

DESIGN, development, or research in power and machinery or soil and water field with college anywhere in U.S.A. Interested in assistantship or similar opportunity to study for advanced degree. BS deg in agricultural engineering, 1950, Allahabad Agricultural Institute of Allahabad University. Experience since April, 1950, as assistant engineer with dealer in a leading American make of farm equipment. Work has included assembly, service, and maintenance of tractors and other machines. Single. Age 23. No disability. Available on notice sufficient to allow time for reaching the U.S.A. Salary $1200. W-383-76

DEVELOPMENT, research, teaching, sales, or writing in power and machinery or rural electrification with industry or public service anywhere in U.S.A. BS deg in agricultural engineering, 1950, University of Georgia. MS deg in agricultural engineering, 1951, Virginia Polytechnic Institute, expected December, 1951. Minor in mechanical engineering. Farm background. Several years sales experience. War noncommissioned service 2½ yr. Half-time research while working on MS deg. Married. Age 27. No disability. Available Dec. 1. Salary open. W-375-77

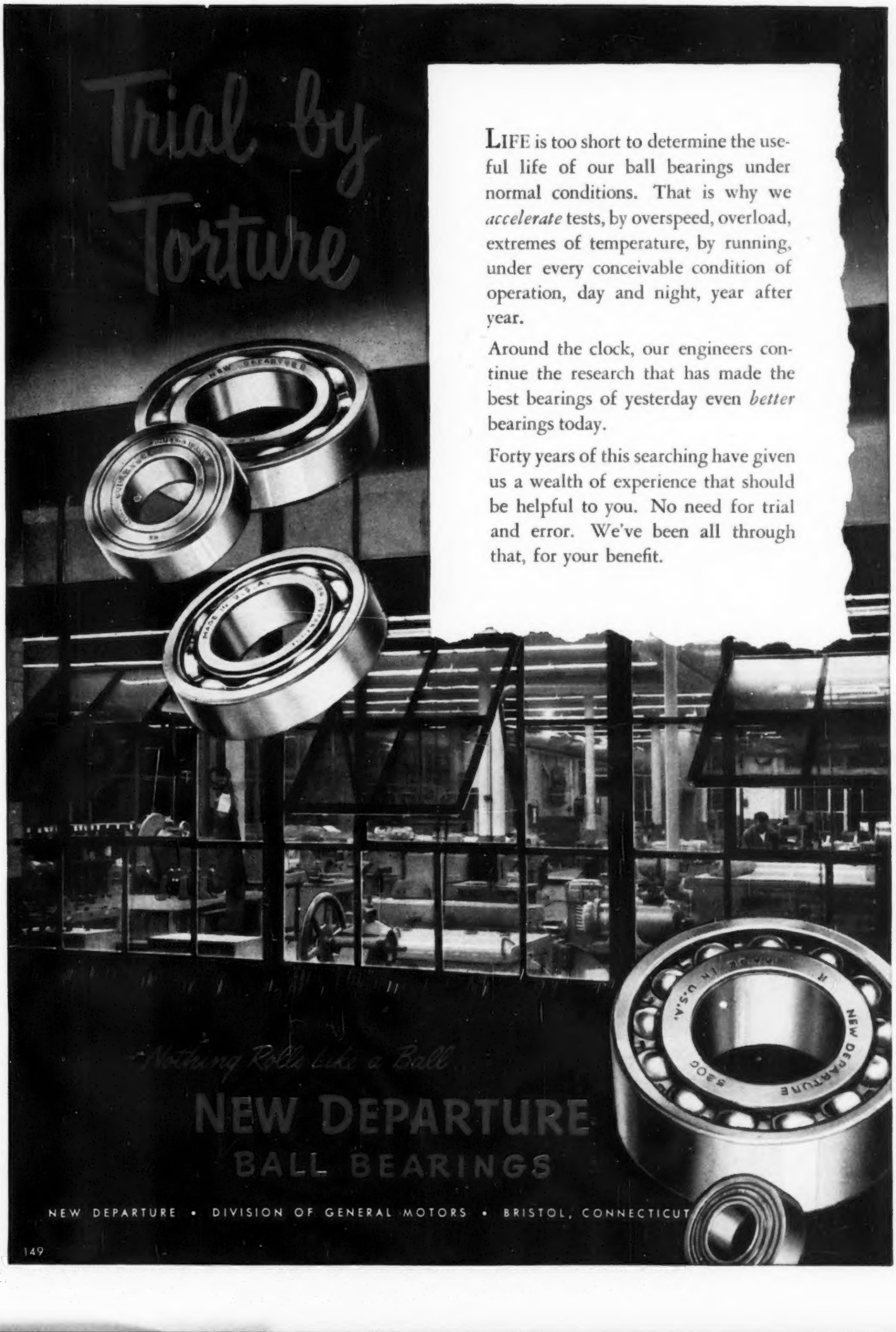
DESIGN, development, service, or construction in farm structures or soil and water field with industry or public service, anywhere in U.S.A. BS deg in agricultural engineering June, 1950, Purdue University. Farm background. General construction experience in carpentry, masonry, and painting part time 1946-51. Resident engineer on municipal water system installations 9 mo. Currently employed in time and motion study and methods with furnace manufacturer. War noncommissioned service in Marine Corps 3½ yr. Married. Age 26. No disability. Available now. Salary open. W-391-78

SALES, service, or engineering in farm power and machinery or irrigation field, with manufacturer or dealer, anywhere in U.S.A. BS deg in agricultural engineering, 1950, Pennsylvania State College. Currently engineering draftsman with aircraft manufacturer. Previous experience in servicing heavy power equipment, as telephone cable splicer, electrician's helper, steel mill worker, and farm hand. War enlisted and commissioned service in Navy 3 yr. Age 30. No disability. Available on reasonable notice. Salary open. W-398-79

NEW BOOKS

PNEUMATIC GRAIN CONVEYING, by G. Segler. Paper, xvi + 174 pages, 5 x 8 inches. Illustrated and indexed. Dr. Ing. G. Segler, Technische Hochschule, (Braunschweig, Germany). $4.50, including postage to points in the United States. Privately published and available for purchase direct from the author in care of Institut fur Landmaschinen, Braunschweig, Muhlenpfordtstr. 307, West Germany

This is an English-language report on investigations pursued by the author over a period of 20 years. It includes chapters on the supply of conveying air for low, medium, and high-pressure systems, conditions in the conveyor pipe line, feeding the grain into the conveyor pipe, and the design of complete conveyor systems. Derivations of equations and descriptions of experimental methods are given in an appendix.


Trial by Torture
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**EVERY NEW FARM TRACTOR HAS TIMKEN BEARINGS...
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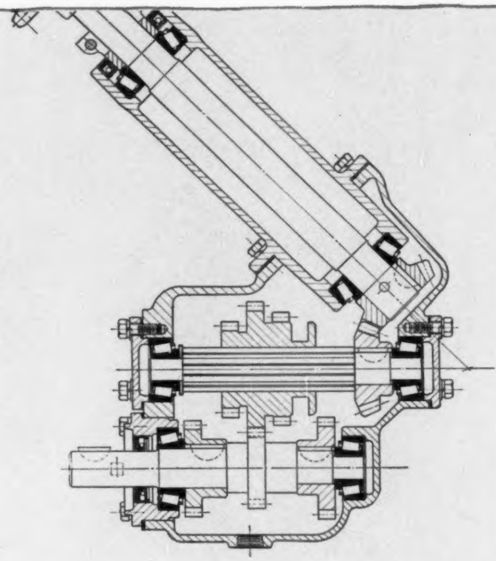

Gearbox of new Allis-Chalmers power driven rake and tedder—another implement in which the agricultural engineer has solved three of his biggest design problems by using Timken bearings.

Driveshaft bearings are mounted cup-adjusted. Shims between carrier and gearcase provide proper adjustment. Timken bearings are also mounted cup-adjusted on sliding gearshaft, with adjustment obtained by cup followers. On bevel gear and sprocket shaft, Timken bearings are cone-adjusted. Bevel gear adjustment is through use of metal shims between flange on carrier and the gearcase. Split collar gives bearing adjustment.

How Allis-Chalmers engineers increased raking speeds in new rake and tedder

WHEN Allis-Chalmers engineers designed their new power driven rake and tedder, they were aiming for higher raking speeds and greater work capacity. So they used Timken® tapered roller bearings in the heavy duty gear box (shown above) and at other vital points.

Since Timken bearings take both radial and thrust loads, deflection and end-play are minimized. Shafts are held in proper alignment and gears mesh accurately. Timken bearings hold shafts and housings concentric so that closures are more effective in keeping dirt out—lubricant in. And with Timken bearings, moving parts rotate freely because smooth surface finish and true rolling motion in the bearing make friction negligible.

By using Timken bearings, three of the biggest design problems facing implement engineers are solved at once: (1) dirt, (2) combination loads, and (3) ease of operation. And implement users are assured of longer implement life, less chance of breakdown on the job, once-a-season lubrication, and higher towing speeds.

For information on Timken bearing applications in farm machinery, write today for your free copy of "Tapered Roller Bearing Practice on Current Farm Machinery Applications." The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

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NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION